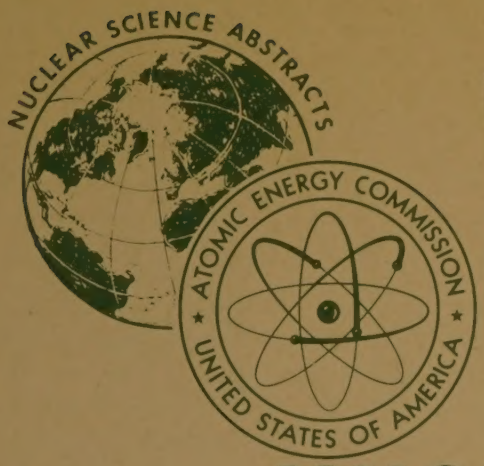

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Volume 15 Number 12A

Abstracts 15323 - 16772

June 30, 1961

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NUCLEAR SCIENCE ABSTRACTS

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Use of funds for printing this publication has been approved by the Bureau of the Budget, July 29, 1960.

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GENERAL AND MISCELLANEOUS

15323 (ARF-3145-4) NON-CHEMICAL METHODS OF ENZYME INACTIVATION. Report No. 4 (Final), April 15, 1959–April 14, 1960. Maurice E. King (Illinois Inst. of Tech., Chicago. Armour Research Foundation). June 13, 1960. Contract DA 19-129-QM-1387. 17p.

A nonchemical method for enzyme inactivation in meat to be used with radiation sterilization was studied. The method is based on heating by electromagnetic energy. The temperature rise depends on the frequence, intensity, and the rate of loss of the energy. Penetration into the material as well as absorption is also important. Adequate penetration is theoretically obtained with maximum absorption at 200 to 500 Mc. Commercial equipment operates either above or below this range, and units operating at 5 to 200 Mc and 1300 Mc were found in initial tests to need extensive modification to heat large meat samples in a short time. Three 2450-Mc electronic ovens were tested for heating ability and effect on proteolysis. Meat was heated and irradiated and the amino acids liberated by proteolytic enzymes after 6 wk at 98°F were assayed by a modified ninhydrin method. Heating in these ovens followed by irradiation inhibited proteolysis. Neither heating nor irradiation alone was effective, and variations did not offer any advantage. The appearance and odor of the meat were good; its final temperature did not influence the proteolysis decrease. Since inhibition was attained with small samples only, further work is necessary to extend the results to large-scale processing. (auth)

15324 (NP-9937) ACTIVITIES REPORT, 1958–1959. (Italy. Comitato Nazionale per le Ricerche Nucleari, Rome). 1960. 56p.

Activities of CNRN for 1958 and 1959 are summarized. Included in the report are discussions of the operation of the first Italian nuclear reactor and related activities, reactor development and related research, nuclear materials, studies and research, research centers, radiobiological research, staff training and public information, and international relations. (M.C.G.)

15325 (NP-9967) DEPARTMENT OF ATOMIC ENERGY REPORT, 1959-60. (India. Atomic Energy Establishment, Trombay). 76p.

The 1959 and 60 annual report of the Indian Department of Atomic Energy is presented. Included are discussions of reactors, production facilities, research activities, industrial operations, and international relations. (M.C.G.)

15326 (NP-9970) RESEARCH SUMMARY NO. 36-7, VOLUME I, FOR PERIOD DECEMBER 1, 1960–FEBRUARY 1, 1961. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Feb. 15, 1961. Contract NASw-6. 101p.

The possible application of gas chromatography to the analysis of lunar materials is being investigated by studies of pyrolysates from organic mixtures. Characteristics of the two minimum energy type trajectories to Venus in 1962 are discussed. A method for specifying the pre-injection standard trajectories was developed using the criteria that at injection the vis viva energy and pseudo-asymptote be satisfied. A mathematical analysis was made of the motion of a satellite in a central force field subject to a constant thrust normal to the instantaneous plane of its motion. A method of finding the error in orbit determination due to radio tracking errors when the measured data are assumed to include range data in addition to range rate and angles is presented. The effect of the earth's equatorial bulge on a circular and rectilinear orbit is considered. The types of assumptions involved in obtaining approximate trajectory solutions for a few basic types of atmospheric entry are discussed. The construction and testing of a set of electronics capable of pulse-torquing a modified accelerometer pendulum over a ±10-g range are described. Development programs at the Deep Space Instrumentation Facility are described. Work performed at the Goldstone, Woomera, and Johannesburg Tracking Stations is described. Communications systems development including mathematics research, communications research, information processing, digital communications techniques, and the Venus Radar Experiment is reported. The development of low-noise amplifiers, antennas for space communication, techniques for the development of thin-films, and a launch spacecraft RF checkout station is also discussed. (M.C.G.)

15327 (R60SD376) STRUCTURAL IMPLICATIONS OF THE IONIZING RADIATION IN SPACE. Norris F. Dow (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). Nov. 30, 1959. Contract AF04(647)-269. 21p.

A review is made of various aspects of the ionizing radiation in space and of their implications for the structural design of manned space vehicles. In all cases the radiation problems are considered from the standpoint of the structural design engineer in an effort to provide guidance toward possible approaches to the structural design problems. One of the most important problems is shown to be the protection of the human beings inside the vehicles from the energetic protons encountered either in the inner Van Allen

radiation belt or sporadically from solar flares at any altitude above 100,000 feet within the solar system. An introduction is made to the design principles involved in both active (electrostatic and electromagnetic) and passive (composite materials) shielding. The conclusion is reached that the protection of the occupants from the hazards of ionizing radiation may require far more weight than any other structural requirement for manned space stations. (auth)

15328 (SCTM-1-61(72)) THE ROMOTAR SYSTEM AT SALTON SEA TEST BASE. W. D. Gutscher (Sandia Corp., Albuquerque, N. Mex.). Mar. 1961. 21p.

A description is given of the ROMOTAR (Range Only Measurement of Trajectory, Automatic Recording) system at Salton Sea Test Base (SSTB). The discussion covers the operation and theory of the complete system, including ground station equipment, transponders, and the playback station. (auth)

15329 (SCTM-79-61(75)) A PROCEDURE FOR SCHEDULING SUPPLIER SURVEYS. D. L. Field (Sandia Corp., Albuquerque, N. Mex.). Mar. 1961. 9p.

A procedure is described for scheduling quality surveys of supplier facilities, processes, and procedures. It is a method of evaluating the complex factors which must be considered in establishing economical scheduling of surveys to insure coverage of the most important AEC suppliers. Special consideration is given to manufacturers of critical items, manufacturers producing for more than one weapon system, and manufacturers with quality problems. (auth)

15330 (TID-3704) INFORMAL LISTING OF BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. Bibliographies Issued or in Progress During Period February–March 1961. (Office of Technical Information Extension, AEC). 25p.

A list is presented of 140 bibliographies issued or in progress during February and March 1961 covering various phases of the atomic energy literature. (C.H.)

15331 (TID-12099) NUCLEAR MATERIALS CONTROL IN RESEARCH AND TEST REACTOR OPERATIONS. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho and General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 1961. Contract AT(45-1)-1350. 50p.

The basic principles and techniques are presented for the establishment and maintenance of a control system for nuclear materials used in research and test reactor operations. Examples of practices used or recommended in similar operations are included. Particular reference is made to the technology of the ETR and MTR. Discussions are given on general control procedures, a typical information system, and techniques for obtaining reliable information. A review is presented of techniques for providing assurance that the application of the system is effective. (B.O.G.)

15332 (TID-12100) NUCLEAR MATERIALS CONTROL IN IRRADIATED FUEL REPROCESSING. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho and General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 1961. Contract AT(45-1)-1350. 103p.

Basic principles and techniques are presented for the establishment and maintenance of a control system for nuclear materials used in reprocessing irradiated reactor fuels. Discussions are included on process technology and logical subdivisions into material balance areas, techniques used in obtaining reliable measurements, and a typical accounting system for maintaining suitable records and reports. A review is presented of techniques for providing assurance that the application of the system is effective. (B.O.G.)

15333 (TID-12324) ENVIRONMENTAL REQUIREMENTS FOR GENERAL PHYSICAL STANDARDS (thesis). H. C. Biggs (Sandia Corp., Albuquerque, N. Mex.). 21p. (SCDC-949)

For presentation at the Fifteenth Annual Meeting, Standards and Metrology Division American Ordnance Association, January 21 and 22, 1960.

The need for controlled environment in measurement in the American nuclear weapons industries is discussed. In developing this thesis, the factors determining the need for control and the methods by means of which this control may be achieved are investigated and certain results that may accrue from informed application of controlled environmental measurement are suggested. (auth)

15334 (VDIT-25) INSURANCE QUESTIONS INCL. THIRD PARTY RISK AND RECOVERY OF DAMAGES IN THE APPLICATION OF ATOMIC ENERGY. A Selective Bibliography. Ernst Bock (Aktiebolaget Atomenergi, Stockholm). 1960. 13p.

This bibliography is intended to give a survey of publications referring to certain insurance questions concerning third-party risk and indemnity arising from the application of nuclear power. It may be concluded from the large number of publications that a uniform international line in the treatment of this subject does not exist. There is, due to the extraordinary magnitude of the economic risk, no agreement between the point of view of the legislator, the nuclear industry, and the insurance institutions with the consequence that the form of insurance, i.e., the compass of the insurance, the degree of coverage, and the third-party risk, is not generally agreed upon. The majority of the publications originate from Central Europe, where under the auspices of the OEEC a convention was held recently on this subject. (auth)

15335 (WADD-TR-60-812) METHODS AND PROCEDURES FOR THE COLLECTION, EVALUATION, AND CONSOLIDATION OF THERMOPHYSICAL PROPERTIES OF MATERIALS. Alexander Goldsmith (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Nov. 1960. Contract AF33(616)-5212. 59p.

Methods and routines for the collection, evaluation, and processing of published physical property data into handbook form are described in detail. Storage and retrieval of information is accomplished by the use of edge-notched, hand-sorted punched cards which are coded for the following indexes: author, year of publication, language, material, property, temperature range, test method, and accession number. A materials index is included that serves to classify materials in the categories of elements, alloys, ceramics, cermets, intermetallics, polymerics, and composites. These methods have been used in the preparation of Thermophysical Properties of Solid Materials (WADC-TR-58-476), a handbook containing over 4000 pages including 1875 individual data sheets, and may be helpful to others undertaking similar tasks. (auth)

15336 DETERMINATION OF THE TIME OF ATOMIC EXPLOSION TESTS ON THE BASIS OF THE ATMOSPHERIC RADIOACTIVITY. Ádám Kovách and Sándor Szalay. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen). Kozlemenyek, 2: 229-36(1960). (In Hungarian)

Systematic measurements of the atmospheric contamination as a result of fission products have been undertaken

since 1952 by the Physics and the Meteorological Institutes of the University of Debrecen and since 1954 by the Atomic Research Institute of the Academy of Sciences. In order to evaluate these data, the time of the explosion should be known with precision; however, this information is available only belatedly and often it is not available at all. Determination of the decay processes of the individual fission products could result in the establishment of the time of the explosion but the large number of the fission products renders this approach impractical. A good approximation is given by the Way-Wigner equation. The validity of this equation was studied for the case of atmospheric precipitations and it was found that best results are obtained by the expression $I(t) = I(1) \cdot t^{-1.18 \pm 0.1}$. By using this method, the time of the individual atomic explosions was determined with an average error of ±2 days up to 1958; since that time the error became larger which may be caused by the increasing contamination of the atmosphere. Data on 31 explosions from 1952 to 1955 are tabulated. (TTT)

15337 NUCLEAR ENERGY IN SPACE. Nucleonics, 19: No. 4, 53-100(Apr. 1961).

High- and low-thrust missions and those requiring high auxiliary power levels are discussed. Strategies of design and operation for reducing danger to populations are also considered. Radionuclide SNAP units provide durable, continuous electric power sources from 1 to 100 w with predictable lifetimes. Uses of SNAP units are discussed. KIWI-B ground tests with flight configurations are described. Problems of high-temperature reactor fuels and engine control during quick startup are investigated. Environmental problems of spacecraft, including particle bombardment, heat flux variations and ultra-high-vacuum materials problems are detailed. Uses of gaseous- and solid-fuel reactors, along with methods for separating propellants and fuels, and the use of atomic explosion propulsion are described. (T.F.H.)

15338 NUCLEAR PHYSICS AND NUCLEAR TECHNOLOGY [ANNUAL SURVEY]. G. Wiesenack (Technische Uberwachungs-Vereine (VdTUV), Essen, Ger.), Heimo Hardung-Hardung, Wolfgang Pohlit, Boris Rajewsky, Georg Propstl, and Hans Kruse. VDI Zeitschrift, 103: 155-65 (1961). (In German)

An annual survey is made of the progress in the fields of nuclear physics and technology. The topics discussed include nuclear power plants and portable power plants, the technology of nuclear fuels, use of radioisotopes in technology, and legal and insurance questions. 128 references. (J.S.R.)

15339 NON-CRYSTALLINE SOLIDS. V. D. Fréchette, ed. Conference on Non-Crystalline Solids, Alfred, New York, September 3-5, 1958. New York, John Wiley & Sons, Inc., 1960. 552p.

Twenty papers are presented from the Conference on Non-Crystalline Solids. Topics covered included radiation scattering, electronic structure, and relaxation phenomena of non-crystalline solids, as well as structures and properties of special systems. (T.F.H.)

BIOLOGY AND MEDICINE

General and Miscellaneous

15340 (A/AC.82/G/L.407) KONTROLINROVANIE ESTESTVENNOGO MUTATSIONNOGO PROTSESSA. (Controlling the Natural Mutation Process). N. P. Dubinin (Akademiya Nauk S.S.S.R.). 1960. 10p.

Natural control of mutation processes, the general increase of mutation by the introduction of mutagenic factors, control of gene mutation or of gene numeric ratios, and general or differential depression of natural mutations are discussed, and various published data are reviewed. Studies of streptomycin depression of mutation in drosophila, using 22.469 chromosomes, showed 0.10% mutations with and 0.41% without streptomycin. Studies show a strong depressing effect of streptomycin on chromosome rebuilding in onion (allium). Hence, streptomycin represents one of the new antimutagenic substances capable of influencing natural mutation process. (R.V.J.)

15341 (A/AC.82/G/L.540) BIBLIOGRAPHY OF PAPERS PUBLISHED IN THE UNITED KINGDOM FROM JUNE TO NOVEMBER 1960 ON RADIOBIOLOGICAL AND ALLIED SUBJECTS. (Gt. Brit. Medical Research Council, London). 1960. 9p. (MRC.60/1340)

Papers (131) published in the United Kingdom between June and November 1960 are cited. (C.H.)

15342 (A/AC.82/G/L.552) PRIMENENIE TRITIYA V BIOLOGICHESKIKH ISSLEDOVANIYAKAH. (Use of Tritium in Biological Research). Yu. M. Shtukkenberg (Akademiya Meditsinskikh Nauk S.S.S.R.). 1960. 84p.

The origin and nuclear properties of tritium are described, and applications of tritium as tracers in studies of hydrogen and water exchange in animals are discussed. Possible isotope effects and tritium fractionation in organisms are considered. Various methods of measuring tritium activity in biological specimens and biosubstrata, the exchange of tritium in albumen with carbohydrates and fats, and tritium exchange in humans are described. Data are given on the biological efficiency, toxicity, and permissible doses of tritium. 93 references. (R.V.J.)

15343 (CEA-1723) QUELQUES EXEMPLES DE L'EMPLOI DES TRACEURS RADIOACTIFS EN PHARMACODYNAMIE. (Some Examples of the Use of Radioactive Tracers in Pharmacodynamics). Y. Cohen (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucleaires, Saclay). 1960. 15p.

The study of absorption, of distribution in the organism, and of the elimination of a drug has been greatly facilitated by the development of nuclear applications. The introduction into the molecule of one or several radioactive atoms makes it possible to follow the path and destination of minute quantities of the drug and to thus carry out analyses on the animal within limits of posology close to those of therapeutics. However, the qualitative or quantitative methods used have certain limits which are compared among themselves and with others. (auth)

15344 (CEA-BIB-12) SCINTILLOGRAPHIE MEDICALE (SCANNING). REVUE DES TRAVAUX RECENTS. (Medical Scanning. A Summary of Recent Investigations). M. Maillard and L. Roule (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 51p.

Scanning methods used in medicine were constantly improved during the last few years; it is now contemplated using merely electronic apparatus instead of mechanical devices, in order to obtain as true as possible a morphological visualization of an organ. Thanks to these new devices, parenchyme lesions could be studied, which up to now were not easily accessible to the usual diagnostic methods. The first investigations in this field were concerned with the thyroid and the liver. Later on, much research work was done on the brain and on vascular and hemopoietic organs. It seems that presently emphasis is placed also on the renal parenchyme. (auth)

15345 (ORNL-3094) INSECT SPECIES ON VEGETATION OF THE WHITE OAK LAKE BED, OAK RIDGE, TENNESSEE. Henry F. Howden and D. A. Crossley, Jr. (Oak Ridge National Lab., Tenn.). Apr. 20, 1961. Contract W-7405-eng-26. 38p.

White Oak Lake, Oak Ridge, Tennessee, received low-level radioactive wastes from Oak Ridge National Laboratory for 12 years prior to draining in 1955. Studies on the insects inhabiting the vegetation on White Oak Lake bed revealed 401 species present during 1956 and 1957. Most numerous were members of the insect Orders Hymenoptera, Diptera, and Coleoptera. In the summer of 1956, the first summer following draining of the lake, there were relatively fewer species of insects represented by large numbers of individuals. In 1957, there were relatively more species of insects but fewer individuals were present. By the end of the summer of 1957, only two years after the lake was drained, the vegetation supported a rich and varied insect fauna. (C.H.)

15346 (TID-11816) BIOLOGICAL, CHEMICAL AND RADIOCHEMICAL STUDIES OF MARINE PLANKTON. Reference No. 61-6. Bostwick H. Ketchum (Woods Hole Oceanographic Institution, Mass.). Feb. 15, 1961. Contract AT(30-1)-1918. 16p.

Progress is reported in a study of the biology, chemistry, and radiochemistry of marine plankton populations from 15 collecting stations in the Atlantic Ocean extending from Montauk Point to the vicinity of Bermuda. A list is included of 17 published papers, 6 papers accepted for publication, and 13 reports on work in progress. These publications describe in detail the progress made. A number of species of oceanic plankton algae were isolated. Nitrifying bacteria were obtained from sea water. A significant amount of organic phosphorus was found in sea water at depths greater than 2000 meters. An intensive study was made of the phosphorus metabolism of unicellular algae, using P^{32} as a tracer. A comparison was made between the uptake of radiophosphorus and radiocarbon by natural phytoplankton populations. A study was continued on the temperature and salinity of the waters over the continental shelf. (C.H.)

15347 (TID-12430) BOVINE LYMPHOCYTIC LEUKEMIA: STUDIES OF OCCURRENCE AND DISTRIBUTION INCLUDING INVESTIGATIONS OF FAMILIAL AND EN-

VIRONMENTAL FACTORS WITH SUPPORTING CLINICAL, HEMATOLOGIC AND PATHOLOGIC STUDIES. Progress Report No. 1, June 1, 1960 to February 15, 1961. D. K. Sorensen (Minnesota. Univ., St. Paul. Coll. of Veterinary Medicine). Contract AT(11-1)-910. 68p.

The annual reports of the Meat Inspection Division of the U. S. Department of Agriculture reveal an increasing frequency of bovine leukemia in the Minnesota region during 1952 to 1959. A study was initiated to obtain information on the frequency of occurrence, geographic distribution, and possible influence of environmental factors. The procedures and approach used are discussed briefly. Each practicing veterinarian in the study area was asked to report all future cases of leukemia that he might see. Information was also obtained on the occurrence of bovine leukemia during the preceding year. The results of the one year retrospective study showed 442 cases of bovine leukemia for the period July 1959 to July 1960. A marked variation in incidence was shown between counties. Multiple cases were noted in 18 herds, but no familial or breed relationship was noted in any of the cases. Information is also being collected on geologic formations and naturally occurring radioactive materials on farms where cases of bovine leukemia occur. Preliminary data are tabulated on factors which may influence the incidence. (C.H.)

15348 (UR-584) DISTRIBUTION AND EXCRETION OF NIOBIUM-95 IN RATS FOLLOWING DAILY ADMINISTRATION IN THE FOOD AND DRINKING WATER. Robert G. Thomas, Randi Lie, Dusan Djuric, Jose Feola, and J. K. Scott (Rochester, N. Y. Univ. Atomic Energy Project). Dec. 15, 1960. Contract W-7401-eng-49. 21p.

Tracer Nb^{95} in oxalic acid solution was added to the food and drinking water of rats and fed daily for thirteen and twelve days, respectively. Serial sacrifices for limited tissue distribution studies were performed throughout and following the feeding period. All food administered, food remaining, excreta, and the whole animals were measured for their γ activity of the isotope, to permit a balance study. Recovery throughout was approximately 94 per cent. Ninety-five to ninety-nine per cent of the niobium ingested, either mixed with food or drinking water, passed directly through the gastrointestinal (GI) tract. The amount entering blood brought the body burden (whole animal minus GI tract and contents) to a steady state value after just a few days of continued ingestion. This steady state value was between two and five per cent of the average daily intake. There is no indication from these data that the currently recommended maximum permissible concentration in water (3×10^{-3} μc/cc for a 40-hour work week) is not valid. (auth)

15349 (JPRS-7886) MEDICAL RADIOLOGY. Translation of Meditsinskaya Radiologiya, Volume 5, No. 10, 1960. 147p.

A comple translation of the journal issue is presented. Separate abstracts have been prepared for the papers. (T.R.H.)

15350 PHYSIOLOGICAL FACTORS INFLUENCING RADIORUBIDIUM FLUX ACROSS ISOLATED RABBIT MESENTERY. W. O. Berndt and R. E. Gosselin (Dartmouth Medical School, Hanover, N. H.). Am. J. Physiol., 200: 454-8(Mar. 1961).

A technique is described for measuring in vitro the permeability of rabbit mesentery to Rb^{86} ion. Equations for passive diffusion are adequate to describe the rubidium flux through this membrane, but unlike passage through collodion, transport through mesentery exhibits a high temperature coefficient. Mesentery reacts in ways that are analogous in some respects to the behavior of intact capillaries. For example, the permeability is increased by lowering the extracellular calcium ion concentration or the pH. Hydroxytryptamine (5-HT) also elevates the Rb^{86} flux, an effect that can be reversed by salicylate but not by lysergic acid diethylamide (LSD). The nature of the transport process is discussed, and it is suggested that isolated mesentery may serve as a useful model for predicting chemical effects on capillary permeability. (auth)

15351 PAROTID SECRETION OF RUBIDIUM. L. L. Langley and R. S. Brown (Univ. of Alabama Medical Center, Birmingham). Am. J. Physiol., 200: 511-12(Mar. 1961).

Parotid secretion of Rb has been studied and compared with secretion of K. K is rapidly transferred by the duct cells of the parotid gland from the plasma to the saliva. The concentration in a series of two-drop saliva samples reaches a peak in about the sixth sample after which the concentration is maintained characteristically high. In contradistinction, other ions display a rapid decrease in concentration. Rb^{86} shows a curve similar to that of potassium. K and Rb respond identically to changes in saliva flow rate. At flow rates of 0.2 or 0.3 ml/min. the concentration of both ions in the saliva is approximately twice that of the plasma. The S/P ratio progressively increases with decreasing flow rates reaching a maximum of about 8 at a saliva flow of 0.01 ml/min. Elevation of the plasma concentration of both ions evokes an increased saliva concentration. It is concluded that Rb is transferred from plasma to saliva by the duct cells of the parotid gland and is transported by the same mechanism responsible for K secretion. (auth)

15352 COMPARATIVE BEHAVIOR OF STRONTIUM–CALCIUM AND CESIUM–POTASSIUM IN THE FOWL. R. A. Monroe, R. H. Wasserman, and C. L. Comar (Cornell Univ., Ithaca, N. Y.). Am. J. Physiol., 200: 535-8(Mar. 1961).

Under normal dietary conditions, but with varying levels of Ca, radiocalcium was preferentially used over radiostrontium as shown by double tracer studies with growing cockerels ($OR_{bone-diet} = 0.6$). With laying hens the bone, egg shell and egg yolk showed the expected OR value of 0.5–0.6; the plasma and egg white, however, showed OR values greater than 1, about 1.5. Studies with Cs^{137} and K^{42} indicated a nonuniformity of accumulation among tissues. The high Cs*/K* ratios in kidney appeared to result from a comparatively lowered capacity for potassium accumulation. (auth)

15353 PRODUCTION OF ANTIBODIES BY QUARTZ AND BERYLLIUM OXIDE. A. Collet, G. A. Voisin, H. Daniel-Moussard, and F. Toullet. Arch. Environmental Health, 2: 409-17(Apr. 1961).

The authors used 3 groups of guinea pigs: a control group, a group given injections of quartz + homologous cells + homologous serum, and a group given injections of beryllium oxide + homologous cells + homologous serum, according to the usual method for maximal immunization. After a time lapse of 40 days, serum samples were obtained from all of the animals in order to test, by the extremely sensitive method of passive cutaneous anaphylaxis, for antibodies against quartz, beryllium oxide, a mixture of quartz + cells + serum, and a mixture of beryllium oxide + cells + serum. All of the animals were likewise tested for intradermal reactivity against the 6 following preparations: quartz, BeO, quartz + cells + serum, BeO + cells + serum, cells alone, serum alone. No antibodies were formed against any of the substances tested. None of the treated animals showed hypersensitivity to quartz, BeO, or homologous

serum. A moderate hypersensitivity was produced in the animals of the 2 treated groups for homologous polynuclear leukocytes. The significance of the above facts is discussed, especially with respect to the pathogenesis of silicosis. (auth)

15354 THE METABOLISM OF LEAD IN MAN IN HEALTH AND DISEASE. Robert A. Kehoe (Univ. of Cincinnati). Arch. Environmental Health, 2: 418-22(Apr. 1961).

The Pb content of the food and beverages consumed daily by the adult citizen of the United States varies from somewhat less than 0.10 mg/day to more than 1 mg/day. The lead inhaled from the atmosphere varies from about 0.01 to 0.09 mg/day. Data on the metabolism of Pb by man in health and disease and public health implications are discussed. (C.H.)

15355 PLUTONIUM EXCRETION. S. Marshall Sanders (E. I. du Pont de Nemours and Co., Aiken, S. C.). Arch. Environmental Health, 2: 474-83(Apr. 1961).

Data are presented on a case of transdermally assimilated Pu which was followed for over 6 years. The patient was treated with a single dose of zirconium citrate, to prevent deposition of Pu in the bone marrow, followed by repeated doses of edathamil calcium disodium, to hasten the excretion of Pu from liver and other soft tissues. The results of this treatment are compared with results from 12 other patients who had accumulated measurable amounts of Pu and who received various treatments. Data are tabulated on urinary excretion of Pu. Calculations of Pu body burden at various times are included. (C.H.)

15356 A PERFUSION STUDY OF THE MOVEMENT OF STRONTIUM ACROSS THE GILLS OF RAINBOW TROUT (SALMO GAIRDNERII). R. H. Schiffman (General Electric Co., Richland, Wash.). Biol. Bull., 120: 110-17(Feb. 1961). (HW-SA-1978).

A perfusion technique for the study of transport across the intact gill of rainbow trout is described. It was found that the outflux rate of 1.6×10^{-6} cm/sec was greater than the influx rate of 5×10^{-8} cm/sec for strontium, and that strontium would go out of a fish gill against a concentration gradient under these experimental conditions. (auth)

15357 MULTIPLICATION OF DIFFERENT VIRUSES AND EVOLUTION OF VIRAL INFECTION IN CELLULAR CULTURES EXPOSED TO THE ACTION OF HEAVY WATER. Jean Lavillaureix, Emilie Reeb, and Albert Surjus (Faculté de Médecine, Strasbourg). Compt. rend., 252: 1871-2(Mar. 20, 1961). (In French)

The multiplication of West Nile, Coxsackie B3, and polio type II viruses is considerably increased if they are inoculated on cells cultivated in the presence of heavy water 5 hr before inoculation. The viral infection can not evolve in the presence of heavy water. (tr-auth)

15358 THE ROUTINE COUNTING OF CARBON-14. M. Peisach (South African Council for Scientific and Industrial Research, Pretoria). J. S. African Chem. Inst., 12: 57-61(1959). (In English)

An improved method of mounting C^{14} labeled barium carbonate is described. Barium carbonate is centrifuged on to a metal plate to produce a thin deposit over a large area. The method permits rapid and easy preparation of samples for analysis. The coefficient of variation of the results is better than 2.5%. (auth)

15359 OCTANOATE OXIDATION IN THE CERIUM-INDUCED FATTY LIVER. Fred Snyder, Fred Baker, John Rafter, and G. C. Kyker (Oak Ridge Inst. of Nuclear Studies, Tenn.). Biochim. et Biophys. Acta, 43: 554-5 (1960). (In English)

A practically complete inhibition of octanoate oxidation by liver mitochondria was observed in rats killed two days after the administration of stable cerium. A wide range of values was observed from days 1 through 6 which was similar to the variation of liver lipids during the onset and recovery phases of fatty infiltration in rats exposed to cerium. Data are presented graphically from which it was concluded that the development of the fatty liver and the recovery of the liver from lipid infiltration depend on the ability of mitochondrial fatty acid oxidizing systems to function properly. Lipid mobilization from extrahepatic tissues appeared to be a significant source of the abnormal accumulation of liver lipids after a single cerium injection. (C.H.)

15360 THE RELATION BETWEEN TUMOUR LETHAL DOSES AND THE RADIOSENSITIVITY OF TUMOUR CELLS. T. R. Munro (Strangeways Research Lab., Cambridge, Eng.) and C. W. Gilbert. Brit. J. Radiol., 34: 246-51(Apr. 1961).

Dose cure-rate curves for tumors were calculated from dose survival curves for single cells, on the assumption that if a tumor is to be cured, every cell in it must be deprived of the ability to continue to reproduce. Host factors were neglected. A value for the radiosensitivity of the cells in squamous carcinomata of the mouth and skin was deduced from a dose cure-rate relation for these tumors. A figure of 134 rads was obtained for the D_0 value of the cells; this is similar to the values which have been reported for a number of kinds of mammalian and human cells irradiated in culture and for a strain of lukemic mouse cells irradiated in vivo. (auth)

15361 PROGRESS AND RATE OF ABSORPTION OF RADIOPHOSPHORUS THROUGH THE INTESTINAL TRACT OF RATS. C. F. Cramer (Univ. of British Columbia, Vancouver). Can. J. Biochem. and Physiol., 39: 499-503(Mar. 1961).

Rates of absorption and the movement of P^{32} through the intestine of adult rats were measured. These two measurements were combined mathematically to estimate the effective contribution of each segment of the intestinal tract toward normal absorption of phosphorus. All parts of the intestinal tract were able to absorb P^{32}. The rate of absorption was greatest at the duodenum, followed by the jejunum, ileum, colon, and stomach in decreasing order. However, since P^{32} passed rapidly through the duodenum and jejunum, less material was available to be absorbed, with the result that absorption was less effective in these segments than it was in the ileum. When the progress and rate of absorption were combined quantitatively, the greatest effective absorption was found to occur in the ileum (which absorbed 38% of the total), followed by the duodenum (29%), jejunum (25%), and colon (8%). Two factors which were found to limit P^{32} absorption were: movement of the isotope into gut segments having slower absorption rate, and decreased absorption of P^{32} in each gut loop with time. Similar factors had been found previously to limit Sr^{89} absorption. (auth)

15362 CHANGES IN RADIOACTIVITY IN THE BLOOD, CARCINOLYTIC AND LEUCOLYTIC PROPERTIES OF THE SERUM DURING THE DEVELOPMENT AND RESOLUTION OF BROWN-PEARCE CARCINOMA. K. P. Balitskii, A. L. Vorontsova, S. F. Gorodetskaya, and I. M. Shevchenko (Bogomolets Inst. of Physiology, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. R.S.R., No. 1, 115-19(1961). (In Ukrainian)

During the development and resolution of a subcutaneously inoculated Brown-Pearce tumor, regular changes occur in the beta activity of the blood, in the carcinolytic and leu-

kolytic criteria of the blood serum of the experimental animals. The beta radiation activity in the blood rose during the first two weeks after inoculation, then, as the tumor resolved, it began to fall, returning to normal in the fifth to sixth week. In the case of a negative transplantation, the fluctuations in activity were slight. The changes in the carcinolytic and leukolytic criteria of serum in the same animals took the form of a drop in these criteria after inoculation and their relative normalization by the time the tumor was resolved. In the case of a negative transplantation the fluctuations were slight. The regularities in the fluctuations are of definite interest and are worth further study. (tr-auth)

15363 STUDIES OF THE SPECIFICITY OF DEOXYRIBONUCLEASE I. II. HYDROLYSIS OF OLIGONUCLEOTIDES CARRYING A MONOESTERIFIED PHOSPHATE ON CARBON 3′. Steven Vanecko and M. Laskowski, Sr. (Marquette Univ., Milwaukee). J. Biol. Chem., 236: 1135-40(Apr. 1961).

When the oligonucleotides obtained by the digestion of desoxyribonucleic acid by splenic desoxyribonuclease are subjected to digestion by pancreatic desoxyribonuclease, neither nucleosides nor mononucleotides are among the products, but mononucleoside 3′, 5′-diphosphates are present. This suggests that monoesterified phosphate in position 3′ labilizes the preceding internucleotide linkage while monoesterified phosphate or free hydroxyl in position 5′ makes the following linkage resistant. The predominant products are dinucleotides and their derivatives, suggesting that they represent the ultimate product of the reaction. Increased hydrolysis can be achieved both by removal of products and increased enzyme concentration. (auth)

15364 INFECTIOUS DEOXYRIBONUCLEIC ACID FROM λ BACTERIOPHAGE. Franz Meyer, Roy P. Mackal, Mabel Tao, and E. A. Evans, Jr. (Univ. of Chicago). J. Biol. Chem., 236: 1141-3(Apr. 1961).

T2 and λ bacteriophage, after treatment with urea, yield infectious material for protoplasts and intact bacterial host cells. After treatment with phenol, λ bacteriophage yields material, presumably desoxyribonucleic acid, which is infectious for protoplasts but not for intact bacterial host cells. Examination of the composition and structure of λ-desoxyribonucleic acid indicates that it has the conventional double stranded configuration. (auth)

15365 RESIN UPTAKE OF I^{131}-TRIIODOTHYRONINE AS A TEST OF THYROID FUNCTION. Kenneth Sterling and Milton Tabachnik (New York State Psychiatric Inst., New York and Columbia Univ., Coll. of Physicians and Surgeons, New York). J. Clin. Endocrinol. and Metabolism, 21: 456-64(Apr. 1961).

A simple, reproducible, in vitro test of thyroid function was developed based upon the uptake of I^{131}-triiodothyronine from serum by the anion exchange resin, IRA-400, in the formate cycle. One milliliter of serum which had been equilibrated with I^{131}-triiodothyronine was added to 1 milliliter of resin in a calibrated tube. The mixture was shaken for ninety minutes and assayed in a well counter. After three washings with water the resin was counted again to determine the resin uptake. The findings are tabulated. The elevated resin uptake values in active thyrotoxicosis fell after therapy. In pregnancy, the values were depressed to the hypothyroid level or lower. Contamination with organic and inorganic iodine did not interfere with the test. (auth)

15366 INCORPORATION OF PALMITIC-$I^{14}C$ ACID INTO BLOOD CELLS. Constantinos J. Miras, Dorothy L. Fillerup, and James F. Mead (Univ. of California, Los Angeles). Nature, 190: 92-3(Apr. 1, 1961).

Palmitic acid-1-C^{14} was incorporated into the lipids of human blood cells during incubation. The procedure is described, and results are discussed. (C.H.)

15367 INCORPORATION OF TRITIUM-LABELLED THYMIDINE IN BUFO ♀ × RANA TEMPORARIA ♂ HYBRID EMBRYOS. R. Tencer (Université Libre, Brussels). Nature, 190: 100-1(Apr. 1, 1961).

Two-cell stages of hybrid embryos resulting from the cross-fertilization of Bufo and Rana temporaria were incubated for 17 hrs in a medium containing tritium-labeled thymidine. The embryos were fixed by freeze-substitution and the incorporation of tritium studied by the radioautographic technique. The embryos stopped development at the late blastula stage. Labeling of desoxyribonucleic acid was demonstrated in morula as well as in blastula cells of the lethal hybrids. Tritium-labeled thymidine was shown to be incorporated into desoxyribonucleic acid 24 hr after development stopped, which suggests that the block in development was not due to the arrest of desoxyribonucleic acid synthesis. (C.H.)

15368 EXCRETION OF RADIOSTRONTIUM WITH THE MOTHER'S MILK IN RATS. G. K. Neumann and H. Kriegel (Heiligenberg-Instituts, Heiligenberg/Baden, Ger. and Justus Liebig-Universität, Giessen, Ger.). Naturwissenschaften, 48: 77-8(1961). (In German)

In the course of studies on the biological behavior of radiofission products in pregnant animals, the excretion of radiostrontium with the mother's milk and the resulting accumulation of Sr^{90} in the new-born during the lactation period were investigated. On the 17th day of gestation, the albino rats used in the study were injected with 20 μc $Sr^{90}-Y^{90}$ as the carrier-free chloride in 0.5 ml NaCl solution. The newborn mice were exchanged with those from controls, so that three groups of rats were obtained. The first group were inactive newborn with active mother, the second active newborn with inactive mothers, and the third active newborn with active mothers. On the 5th, 10th, 15th, and 20th day after birth, animals were sacrificed and the amount of strontium determined as a percentage of the strontium injected into the mother. The results show that in the young animals which received Sr^{90} in the mother's milk but which were born of inactive mothers, the Sr^{90} content increased. In the new-born which received radiostrontium during the placental period but were fed with Sr-free milk, the Sr^{90} content remained constant for the first 15 days, but decreased when the animals received standard food. The young animals of the third group receive radiostrontium with the mother's milk, and the strontium concentration in the animals increase. The sacrifice of the mothers on the 20th day after birth showed that the strontium content was 0.35% of the injected dose. (J.S.R.)

15369 PRESERVATION OF LIVING CELLS AND APPLICATIONS TO BONE MARROW. Phan The Tran and M. A. Bender (Oak Ridge National Lab., Tenn.). Rev. franç. études clin. et biol., 5: 1020-9(1960). (In French)

Mammalian bone marrow cells, as well as other tissue cells, can be kept alive frozen for long periods. Each cell type presents special problems, but some general conclusions can be drawn as to the most suitable methods for preservation. Slow freezing gives good results if protecting compounds are added, usually 15 p/100 glycerol. To freeze cell suspensions to −25°C it is suitable to cool at the rate of one degree per minute; beyond this temperature it is preferable to cool more quickly. The cells should be stored at the lowest possible temperature, preferably be-

low—50°C. Liquid nitrogen ensures optimal preservation. Defreezing should be as rapid as possible. When using frozen marrow it is best not to remove the protective substance. In the preservation of marrow from large mammals, such as man, the technical problems are complicated by the volume of marrow and the large quantities of blood present. These difficulties can be overcome by methods for separating cells. 104 references. (auth)

15370 BLOCKADE OF DEOXYRIBONUCLEIC ACID SYNTHESIS BY DEUTERIUM OXIDE. Paul R. Gross and Clifford V. Harding (New York Univ., New York; Columbia Univ., New York; and Marine Biological Lab., Woods Hole, Mass.). Science, 133: 1131-3(Apr. 14, 1961).

Interference with desoxyribonucleic acid replication need not be a primary mechanism in the blockade of cell division by deuterium oxide, but current hypotheses on the molecular basis of the blockade do suggest that such interference might take place under appropriate conditions. Autoradiographic experiments support the suggestion, for whereas normal sea urchin eggs incorporate H^3-thymidine into desoxyribonucleic acid from almost the beginning of development, cells immersed in deuterium-enriched media do not. Blockade of mitosis and inhibition of thymidine incorporation are simultaneously relieved when the eggs are returned to normal water. (auth)

15371 POSSIBILITIES OF ACTION OF SENSITIZING OR DESENSITIZING ADDITIVES IN RADIATION CHEMISTRY AND RADIOBIOLOGY. REPORT I. BASIC PROBLEMS OF RADIOCHEMICAL SENSITIZATION. Günther O. Schenck, O.-Albrecht Neumüller, and Ruprecht Koch (Max-Planck-Institut für Kohlenforschung, Mulheim/Ruhr, Ger. and Universität, Freiburg i B.). Strahlentherapie, 114: 321-36(Mar. 1961). (In German)

The effects of sensitizing or desensitizing substances on the different steps of the free-radical-type reaction sequence, i.e., initiation, propagation, and termination, and on the after-reactions are discussed and illustrated. In photochemistry the O_2-transfer by excited sensitizers via a purely biradical mechanism is to be distinguished from the biradical-monoradical type of sensitized autoxydation with primary dehydrogenation of H-donators by excited sensitizers. Further emphasis is laid on the distinction whether the sensitizer exerts an influence on the radiation-chemical reaction sequence via absorption of radiation energy or merely as a catalyst. (auth)

15372 ANIMAL EXPERIMENTS, HISTOLOGICAL, AND DOSIMETRIC STUDIES OF A SIMPLE RADIOBIOLOGICAL MODEL AND ITS PRACTICAL APPLICATIONS. REPORT I. RADIATION INJURIES FROM PARTIAL IRRADIATION OF THE TAILS OF WHITE MICE. Ludwig Rausch and Emil Unger (Universität, Marburg/Lahn, Ger.). Strahlentherapie, 114: 337-54(Mar. 1961). (In German)

After introductory remarks about several simple models used in animal experiments, partially self developed or perfected and made within the frame-work of a larger animal experiment study on sieve- and grid irradiation, the first model, the radiation damage of the partially irradiated mouse tail, is described. Thereby the literature, experimental technique, macroscopic course, its causal histopathological changes, exact statements about the dosimetry and finally purposeful experimental dispositions, kind of evaluation and applicability of the model for the most varied radiobiological purposes are discussed. (auth)

15373 A REPORT ON THE RADIOSENSITIVITY OF HUMAN BONE MARROW. Bruno Choné (Universität, Heidelberg, Ger.). Strahlentherapie, 114: 355-69(Mar. 1961). (In German)

By means of clinical-radiological patient material purposeful bone-marrow studies were made. Of special interest were the local marrow changes lying within the radiation region. An attempt was made to comprehend these in their temporal dynamics. On principle no modification of the usual radiation therapy took place. The examinations were limited to the cobalt-60-unit, whereby no qualitatively different results as opposed to the conventional x-ray radiation resulted. The alteration process in radiated bone-marrow ran continually and uniformly. The regeneration tendency is surprisingly big. Reactions on the general blood status are as a result not primarily of value as radiation effects. In the action character there exist relations between ionizing radiation and cytostatica. The necessity of a functional connection of the morphological findings with radioisotopes is finally pointed out. (auth)

15374 FUNDAMENTALS OF RADIOBIOLOGY. Completely Revised Second Edition. Z. M. Bacq and Peter Alexander. International Series of Monographs on Pure and Applied Biology. Division: Modern Trends in Physiological Sciences. Volume 5. New York, Pergamon Press, 1961. 566p. $12.00.

A comprehensive review is presented of recent concepts of reaction mechanisms involved in the development of radiation injuries in biological systems. The sequence of events at the molecular level is outlined and both direct and indirect effects of radiation are considered. The importance of the chemical environment in response of the organism to radiation exposure and the essential role of the metabolic state in the development of radiation lesions is stressed. (C.H.)

Biochemistry, Nutrition, and Toxicology

15375 (AHSB(RP)-R-5) THE RELATIVE INHALATION HAZARDS FROM THE RADIOISOTOPES OF IODINE FOLLOWING ACCIDENTAL RELEASE OF FISSION PRODUCTS. G. W. Dolphin and S. A. Beach (United Kingdom Atomic Energy Authority. Authority Health and Safety Branch. Radiological Protection Div., Harwell, Berks, England). Jan. 1961. 16p.

The relative inhalation hazards of iodine isotopes following an accidental release of fission products are calculated taking into account the biological and physical characteristics of the significant radionuclides. The relative dose due to I^{132} formed in the body by the decay of Te^{132} is also calculated using a simple mathematical model for iodine metabolism. The calculations are made for various decay times following the accidental release of fission products from irradiated reactor fuel elements and from a criticality incident. (auth)

15376 (NP-9578) THE NUTRITIONAL ADEQUACY AND PROBABLE TOXICITY OF FOODS PRESERVED BY IONIZING RADIATIONS. Progress Report No. 14, [Covering] Period March 14, 1960 to September 15, 1960. Merrill S. Read, Howerde E. Sauberlich, William S. Worth, Harold M. Trabosh, and Richard S. Harding (Army Medical Research and Nutrition Lab., Denver), and Norman F. Witt (Colorado. Univ., Boulder). Contract DA-40-007-MD-549. 7p.

Further evaluation of a possible relationship between vitamin K deficiency and liver cytochrome oxidase or succinic dehydrogenase was performed. Although results indicate that the liver cytochrome oxidase activity is increased in rats fed a vitamin K-deficient diet (Johnson-type), a direct relationship of enzyme activity to vitamin K intake does

not appear to be evident. A similar conclusion is indicated for liver succinic dehydrogenase. Other factors in the diet appear to play a greater role in cytochrome oxidase activity than does vitamin K. Erythrocyte transketolase activity in the rat was found to be related to the dietary intake of thiamine. The addition of sorbitol or the use of high levels of fat in the diet retarded the drop in RBC transketolase that resulted from the feeding of a thiamine-deficient diet. (auth)

15377 (NP-9582) HEMORRHAGIC SYNDROME IN RATS FED IRRADIATED BEEF. Progress Report No. 4 [For] Period March 15, 1960 to September 15, 1960. E. A. Doisy, Jr. and J. T. Matschiner (Saint Louis Univ. School of Medicine). Contract DA-49-007-MD-996. 23p.

Further evidence was adduced to show that vitamin A and hemorrhagenicity of a given diet are closely interrelated. The present work also bears out the findings of the Illinois workers concerning the prothrombin-lowering effect of 0.5% Decanal, and the severity of hypoprothrombinemia as the result of feeding soy protein. In addition, data are presented showing that restriction of vitamin A from diets of lactating females renders nursing pups more susceptible to hemorrhage. A new assay for screening potentially hemorrhagenic diets was proposed, using adult animals. Preliminary data from examination of fractions of fresh and irradiated beef employing the new assay are presented. (auth)

15378 (TID-11940) PATHWAYS OF NUCLEIC ACID SYNTHESIS. [Progress Report], February 1, 1960–January 31, 1961. Richard Abrams (Montefiore Hospital. Inst. of Research, Pittsburgh). Feb. 15, 1961. Contract AT(30-1)-1818. 31p.

On the assumption that the cell nucleus is a major site of RNA synthesis, enzyme systems involved in polynucleotide synthesis in this organelle were investigated. An enzyme was isolated which is specific for CTP incorporation. The enzyme was resolved into specific RNA primer components and a protein component. The primers are not interchangeable. Priming of the ATP polymerization was investigated in some detail with various nucleases. The data suggest that the natural primer is either a polyadenylic acid or a polynucleotide containing as its active portion a sequence of adenylate units. Thus poly A can prime the reaction, while the natural primer is resistant to pancreatic RNase and takadiastase-T_1 RNase but destroyed by squid RNase. The CTP enzyme preparation carries out both internal and terminal incorporation, and the data suggest these may represent two separate enzymes. The physiological role of these enzymes is still obscure. A particulate system obtained after homogenizing calf thymus nuclei and extracting the residue exhaustively with Tris buffers was also investigated. The particulate residue incorporates nucleoside triphosphates into RNA only if all four triphosphates are present. The composition of the newly formed RNA resembles that of nuclear RNA more closely than that of DNA. The preparation contains protein, RNA, and DNA in a ratio of 1:0.3:3.0. The RNA is essential for the incorporation reaction since the particles are inactivated by treatment with squid RNase and the activity restored by addition of its own RNA. The role of DNA is uncertain. Treatment with DNase inhibits the reaction, but efforts to restore activity with added DNA failed. Incubation at 37° results in transfer of RNA from the particles to the soluble phase. The possible significance of this reaction in transfer of genetic information merits further study. Results are also reported from a study of the mechanism whereby guanine is converted to hypoxanthine in rat liver extracts. Results indicate that the reaction occurs at the free base level, the pathway involving deamination by guanase to xanthine, reduction by DPNH and xanthine oxidase to hypoxanthine, and stabilization at the hypoxanthine oxidation level by conversion to inosine in the presence of nucleoside phosphorylase. (auth)

15379 (TID-12440) THE USE OF RADIOISOTOPIC METHODS TO STUDY THE BIOSYNTHESIS OF INDOLE-LIKE COMPOUNDS. Progress Report No. 3, May 15, 1960 to May 14, 1961. Robert J. Suhadolnik (Oklahoma. Agricultural Experiment Station, Stillwater). Feb. 15, 1961. Contract AT(11-1)-71. 7p.

Progress is reported in studies on the characteristics of the naturally occurring indoline cyclic disulfide, gliotoxin. Data are included from tracer studies on the enzymic reduction of the cyclic disulfide moiety; the stability of the reduced dithiol; the antibiotic activity of the reduced gliotoxin toward E. coli; the production of gliotoxin by the fungi, T. viride, using resting mycelium to study the incorporation of sulfur; the enzymic hydroxylation of p-fluorophenylalanine and incorporation into gliotoxin; and the biogenesis of the amaryllidaceae alkaloids, with emphasis on narcissidine. (C.H.)

15380 (AEC-tr-4417) DETERMINATION OF THE QUANTITY OF RADIOACTIVE SUBSTANCES IN AN ORGANISM ON THE BASIS OF THEIR EXCRETION. T. Trnovec. Translated from Pracovni lekarstvi, 11: 206-15(1959). 31p.

It is pointed out that the increasing use of radiation in science, industry, and medicine, and the utilization of the chain reaction in the production of electrical energy increases the risk of elevating the level of radioactive substances in a large number of workers. Quantitative means of determining levels of internally deposited radioactivity are discussed. Determination on the basis of excreta radioactivity, the method of choice when the radiation does not penetrate the organism, and cases in which the radioactive substance does not decompose into gas are considered. A knowledge of the quantitative ratio between the radiation from a certain radioactive substance and the amount present in the organism is assumed. Equations are presented for use in calculating the amount of radioactive material in an organism from the quantity excreted. Applications of both exponential functions and power functions in calculating the excretion are discussed. 98 references. (C.H.)

15381 (CEA-tr-R-1173) QUELQUES REMARQUES SUR L'ARTICLE DE LEBEDEVA G.D. "LE PLANCTON COMME INDICATEUR DE POLLUTION DES CITERNES D'EAU DOUCE PAR DES SUBSTANCES RADIOACTIVES." (Some Remarks on the Article by G. D. Lebedeva "Plankton as Indicator of Pollution of Fresh-water Cisterns by Radioactive Substances"). Translated into French from Med. Radiol., 3: No. 4, 91-6(1958). 6p.

It is pointed out by M. G. Shandala that the method of weighing, calculating, and reporting used by Lebedeva has led to errors. A. N. Marey as referee supports the position of Lebedeva in that the drying and weighing technique and the units of activity used are appropriate and accepted. (T.R.H.)

15382 (JPRS-7886(p.46-50)) THE USE OF BLOOD SUBSTITUTES FOR POLONIUM INJURY (PRELIMINARY COMMUNICATION). Yu. V. Vissonov. Translated from Med. Radiol., 5: No. 10, 35-8(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 5890.

15383 (JPRS-7886(p.77-84)) MAXIMUM PERMISSIBLE CONCENTRATION OF SHORT-LIVED DAUGHTER PROD-

UCTS OF RADON FISSION. I. L. Shalaev (Shalayev). Translated from Med. Radiol., 5: No. 10, 56-61(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 6292.

15384 (JPRS-7886(p.105-12)) THE TRANSFER OF STRONTIUM FROM MOTHER TO OFFSPRING. Yu. D. Parfenov. Translated from Med. Radiol., 5: No. 10, 75-8 (1960).

A review is presented of studies of the transfer of Sr from mother to offspring. There are two routes, the first one discussed being the placental. The quantity of Sr retained by the embryo as a result of placental transfer is quite great. The distribution is similar to that in adults, and deposition is mainly in tissues containing Ca. The Sr comes chiefly from that circulating in the blood, and the quantity is directly proportional to that circulating in the blood. The significance of the time factor for retention of Sr by the fetus is closely connected with the calcification activity in the developing skeleton. The presence of Ca exerts a considerable effect on Sr retention, low Ca diets causing greater retention. Transfer by lactation is the second route. The Sr level in the milk is constant. Evidence indicates that lactation can take Sr from the bones if it entered the body during lactation. The presence of Ca effects this route in the same way as it does the other. The amount of Sr transferred by lactation is greater than that by the placenta. Despite the relative smallness of it, the Sr absorbed by an embryo can produce definite consequences. (27 references). (T.R.H.)

15385 (JPRS-7886(p.113)) ELECTROCARDIOGRAPHIC CHANGES IN DOGS INTOXICATED WITH THORIUM. I. A. Frolova. Translated from Med. Radiol., 5: No. 10, 79 (1960).

Five dogs were exposed to a ThF_4 aerosol 2 hours/day for a week, and five dogs 30 min/week for 6 months, and compared to dogs exposed to NaF and to controls by an electrocardiogram. The electrocardiogram was taken normally and after intravenous injection of adrenalin (2.5 and 5 gamma/kg). Toxic signs of extrasystoles, complete and incomplete atrioventricular block, brief paroxysmal tachycardia, auricular flutter, and appearance of heterotopic foci of excitation were observed to a greater degree and with greater constancy in the first group. In the third group, scattered extrasystoles were found in only one dog after adrenalin administration. These phenomena were not observed in the control dogs. (T.R.H.)

15386 (JPRS-7886(p.118-19)) STUDY OF THE SULFHYDRYL GROUP CONTENT IN SOME RAT ORGANS AFTER POLONIUM INJURY. M. G. Zotova. Translated from Med. Radiol., 5: No. 10, 81(1960).

A study was made of changes in the content of free –SH groups in a homogenate of some organs after acute intoxication by Po with the use of unithiol as a therapeutic agent. Po was injected once subcutaneously at 0.1 millicurie/kg causing an acute course of the injury and death on the 13th to 20th day. Unithiol, $HS-CH_2-(SH) \cdot CH_2SO_3Na \cdot H_2O$, was injected subcutaneously as a 5% aqueous solution at 100 mg/kg twice/day for 6 days. A reduction of –SH groups occurred in all organs after the third to fifth day, the reduction being greater in organs where the Po deposited. The unithiol caused less reduction and delayed the reduction. The use of unithiol in the late periods was not effective. (T.R.H.)

Fallout and Ecology

15387 (A/AC.82/G/L.543) SODERZHANIE Sr^{90} V POCHVE I RASTITEL'NOM POKROVE MOSKOVSKOI OBLASTI. (Strontium-90 Content of the Soil and Vegetation of the Moscow Region). P. M. Chulkov (Akademiya Nauk S.S.S.R.). 1960. 6p.

The rates of Sr^{90} uptake by soil (2 to 5 cm in depth) and vegetation, monitored during July and August, within a 40 to 45 km radius around Moscow are tabulated. The obtained data indicate a 4-fold increase of Sr^{90} in the soil in 1959 as compared to the accumulation up to July 1956. However, in comparison to 1958 the increase is comparatively small. The same data hold for vegetation. (R.V.J.)

15388 (A/AC.82/G/L.544) SODERZHANIE Sr^{90} V MOLOKE RAZNYKH RAIONOV SSSR V 1959. (Strontium-90 Content of Milk in Various Districts of the USSR in 1959). V. I. Novgorodtseva and N. I. Borisova (Akademiya Nauk S.S.S.R.). 1960. 7p.

The pattern of fall-out Sr^{90} was monitored using dry milk samples collected from various districts. The results of analyses for the third quarter of 1959 are tabulated by district; in most places the contamination increased by a factor of 2 over the 1956-57 period. (R.V.J.)

15389 (A/AC.82/G/L.548) ISSLEDOVANIE SODERZHANIYA STRONTSIYA-90 V KARTOFELE, MOLOKE I RASTITEL'NOM POKROVE LENINGRADSKOI OBLASTI (1957–1959). (Study of Strontium-90 Content of Potatoes, Milk and Vegetation in the Leningrad Region (1957–1959). V. P. Shvedov, M. I. Zhilkina, and L. M. Ivanova (Akademiya Nauk S.S.S.R.). 1960. 17p.

Environmental contamination from weapon tests was monitored in the Leningrad district by estimating the uptake of Sr^{90} by milk, potatoes, and grass. Radiochemical tests carried out from 1957 to 1959 indicated a general increase of Sr^{90} levels in potatoes from 0.8 to 2.3 μc, in milk from 3×10^{-12} to 9×10^{-12} c/l, and in grass to 608.2 μc. A comparison of the 1959 Sr^{90} content in potato and grass ash showed 850 μc per 100 g of grass ash and 30 μc per 100 g of potato ash. (R.V.J.)

15390 (CEA-1728) LES PARAMETRES D'EQUILIBRE DU STRONTIUM 90 DANS LE SOL DE SACLAY. (The Strontium-90 Equilibrium Parameters in Saclay Soil). Pierre Cohen and Claude Gailledreau (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). 1960. 47p.

The equilibrium parameters of Sr^{90} in the presence of Ca, Na, K, and NH_4 were measured in soil for each of the pairs Sr-Ca, Sr-Na, Sr-K, and Sr-NH_4. The adsorption mechanism for Sr was studied in comparison with a synthetic resin which is a pure ion-exchanger. A preliminary study of a three component system, one being a tracer, is outlined. (auth)

15391 (TID-12371) TECHNICAL PROGRESS REPORT TO THE U. S. ATOMIC ENERGY COMMISSION [ON ECOLOGY], 1960-61. William S. Osburn (Colorado Univ., Boulder. Inst. of Arctic and Alpine Research). Feb. 1961. Contract AT(11-1)435. 27p.

Progress is reported in studies on plant ecology in the Rocky Mountains and possible effects of natural and artificial radioactivity on the growth and development of plants. Measurements were made of environmental conditions and radioactivity at various elevations up to 12500 ft. Transplant gardens were established in proximity to key environment measurement stations at 7200, 8500, 10000, and 12280 ft elevations. Two areas were found to have levels of ionizing radiation significantly higher than the national average background. The radioactivity of one area was mainly γ and was found to emanate from the relatively high content of U and Th elements within soil and bedrock on a Bostonite dike at an altitude of approximately 8000 ft. The radio-

tivity of the second area was essentially all β and peared to result from fall-out concentration by ecological processes in snow at 11400 ft. Fall-out radioisotopes ere also found to be accumulated in potholes in a relatively steep cliff. Results of analyses of samples of rain nd snow from various altitudes indicate that the altitudinal istribution of fall-out is not only related to the amount of recipitation, but also the length of time between storms, mount of dust in the air, length of time for equivalent mounts of precipitation to fall, type of snowfall, time of ear, and source of air mass. Studies on the growth rate nd productivity of pea plants grown from seeds exposed to oses of 0 to 5000 rads and grown at various altitudes led o the conclusion that it is necessary to obtain information n all environmental factors simultaneously rather than easuring radiation alone. A list of papers and publicaons during the period is included. (C.H.)

5392 (TID-12374) THE LOSS OF ORGANIC AND INRGANIC MATERIALS FROM ABOVE-GROUND PLANT ARTS, WITH ESPECIAL REFERENCE TO DECONTAMIATION OF PARTS UTILIZED FOR FOOD. Progress Reort. H. B. Tukey, Jr. (Cornell Univ., Ithaca, N. Y.). 1961]. Contract AT(30-1)-2598. 6p.

Progress is reported in tracer studies using Ca^{45}, P^{32}, Sr^{89}, and S^{35} to determine the loss of nutrients from the oliage of several plants by the leaching action of simulated ain and dew. Seedlings of bean, cucumber, tomato, and innia, and rooted cuttings of chrysanthemum, coleus, and eranium were placed in solutions containing the radioisoopes. After two to three weeks, the plants were exposed or 24 hr to a mist spray of distilled water. The spray was ollected and analyzed for the radioactive elements. The tems and foliage of the leached plants were also analyzed or radioactivity. Preliminary results indicate that the four adionuclides can be leached from all the plant species studied in varying amounts. Loss of nutrients occurred in similar amounts from chrysanthemum and coleus plants which were flowering as from vegetative plants. Preliminary results are included from a study of the nature of the leachate from leaves. (C.H.)

15393 ABILITY OF SOME BLACK SEA ORGANISMS TO ACCUMULATE FISSION PRODUCTS. G. G. Polikarpov (Biological Station, Academy of Sciences, Sebastopol, USSR). Science, 133: 1127-8(Apr. 14, 1961).

The coefficients of accumulation of Sr^{90}, Cs^{137}, and Ce^{144} in seaweeds, eelgrass, actinia, mollusks, and crustaceans are presented. The discharge of Sr^{90} into sea water from decomposing seaweed and the retention and additional absorption of Cs^{137} and Ce^{144} onto organic debris is discussed. Some observations are made about the ability of these elements to diffuse into sea water and about the relative hazard to man from Sr^{90} and Ce^{144} in marine life. (auth)

Radiation Effects on Living Tissues

15394 (A/AC.82/G/L.408) VLIYANIE MALYKH DOZ IONIZIRUYUSHCHEI RADIATSII NA CHASTOTU VOZNIKNOVENIYA STSEPLENNYKH S POLOM RETSESSIVNYKH LETAL'NYKH MUTATSII U DROZOFILY. (The Influence of Small Doses of Ionizing Radiation on the Frequency of Sex-Linked Recessive Lethal Mutations in Drosophila). Ya. L. Glembotskii, E. A. Abeleva, and Yu. A. Lapkin (Akademiya Nauk S.S.S.R.). 1960. 14p.

Gamma irradiation of drosophila sperm and spermatide by 5 r induces recessive lethal mutations. Fractionated irradiation with 20 r, at 5 r per exposure at 1.5 hours intervals, resulted in cumulative mutagenic effects. Identical doses of fast neutrons produced 1.5 to 2-fold higher mutagenic effects. The spermatide mutability resulting from exposure to fast neutrons and γ radiation is two-fold stronger than in sperm. Experiments with doses up to 5 r indicate no thresholds for the mutagenic effect. (R.V.J.)

15395 (A/AC.82/G/L.409) RADIOCHUVSTVITEL'NOST RAZNYKH STADII SPERMATOGENEZA U DROSOPHILA MELANOGASTER. (The Radio-Sensitivity of Different Stages of Spermatogenesis in Drosophila Melanogaster). E. A. Abelev and N. A. Potekhina (Akademiya Nauk S.S.S.R.). 1960. 8p.

The development of dominant lethals in irradiated 24-hour-old Drosophila Melanogaster sperms and spermatides was investigated. Single exposure to 2400 r, 3 exposures to 800 r at 1.5 hour intervals, single exposure to 400 and 1200 r, and 3 exposures to 400 r at 3 hour intervals were used. Radiosensitivity at various stages of spermatogenesis was evaluated. (R.V.J.)

15396 (A/AC.82/G/L.411) GENETICHESKII EFFEKT RADIATSII U MIKROORGANIZMOV PRI RAZLICHNYKH PERESTROIKAKH YADERNYKH STRUKTUR. (The Genetic Effect of Radiation in Micro-Organisms on Various Rearrangements of the Nuclear Structures). S. I. Alikhanyan and S. V. Kameniva (Akademiya Nauk S.S.S.R.). 1960. 15p.

The influence of the genotype of an organism on the genetic effects induced by radiation is analyzed. The change in radiation genetic effects due to the change in the number of nuclear structures in the cell and the effects of the reconstruction of nuclear structures on the response of separate genes were investigated in two groups of penicillin strains. The dipole family 48/66 consisting of four strains, two initial haploids, the diploid itself, and recombination diploid and diploid 16/66, also consisting of two haploids, the diploid and recombination were studied using ultraviolet and x rays. The data show that a much larger number of morphological changes showed up in diploid strains irradiated by ultraviolet rays than in haploid strains. A larger number of morphological changes were also found in x-irradiated dipole cultures. Tests with double biochemical E. coli mutants show that the interactions of genes are capable of stopping or slowing down induced changes and vice versa. (R.V.J.)

15397 (A/AC.82/G/L.412) OBRATIMOST TSITOGENETICHESKIKH POVREZHDENII VYZVANNYKH RADIATSIEI. (The Reversibility of Cytogenetic Damage Caused by Radiation). N. V. Luchnik, N. A. Izmozherov, N. A. Poryadkova, L. S. Tsarapkin, and H. V. Timofeev-Resovskii (Akademiya Nauk S.S.S.R.). 1960. 16p.

Data on the nature of initial radiation-genetic injuries and their restoration were analyzed, and the number of abnormal anaphases at various times after soaking irradiated (with 15,000 r) seeds in water and cystein solutions were counted. The ratios of various mutations indicate cystein has a beneficial effect on radioinduced aberrations and support the postulation on the development of true aberrations and restoration. Similar tests made at various time intervals with seedlings show restorative processes. These tests also confirmed a theory on the realization of potential injuries during the autoproduction process. The percentage of cell restoration was evaluated by a formula based on the ratio of the number of fragments to the number of cells with fragments. Further correlations of this percentage were made with general restoration determined by the ratio of local and cell-process restorations. The effects of various physical, chemical, and biological factors on restoration in irradiated pea and wheat seeds are analyzed. (R.V.J.)

15398 (A/AC.82/G/L.414) PRICHINY RADIOUSTOICHIVOSTI RASTENII. (Causes of Radio-Resistance in Plants). V. V. Khvostova and L. V. Nevzgodina (Akademiya Nauk S.S.S.R.). 1960. 10p.

Air-dried field pea seeds exhibit stronger γ-radiation resistance than the edible "Capital" variety (the anaphase with chromosome rearrangement at first mitosis in roots is taken as injury criterion), while to fast neutrons the resistance of both varieties is identical. After storage, γ-irradiated peas showed a regular increase in chromosome recombination in the more radiosensitive edible peas while in the more resistant field peas such regularity was not observed. It is postulated that in the γ-sensitive peas the potential chromosome injuries have a stronger tendency to change into true aberrations due to the bio-chemical properties of their cells. (R.V.J.)

15399 (A/AC.82/G/L.415) OTNOSITEL'NAYA GENETICHESKAYA RADIOCHUVSTVITEL'NOST RAZLICHNYKH VIDOV MLEKOPITAYUSHCHIKH I DROZOFILY. (The Relative Genetic Radio-Sensitivity of Various Species of Mammals and of Drosophila). N. I. Shapiro, E. D. Plotnikova, S. I. Stroshnenko, and V. I. Suslikova (Akademiya Nauk S.S.S.R.). 1960. 31p.

Tests were made with 2.5- to 4-month-old white mice and rats weighing 19 to 25 g and 190 to 250 g respectively and 5- to 8-month-old rabbits of 3 to 4 kg. The mice were exposed to local (testis) irradiations of 134, 268, 402, and 670 r at 36 to 40 r/min; the rats to 134, 268, and 750 r; and the rabbits to 150, 300, 450, 600, and 750 r. Embryo deaths in non-exposed females mated to irradiated males were tabulated and analyzed as dominant lethals developed in male spermatozoid. The genetic radiosensitivity of the animals is expressed by the following sequence: mice < rats < rabbits. The genetic radiosensitivity in rabbits is about 1.5 to 2.5 times that in mice. Moreover, in contrast to mice and rats the induced dominant lethals in most cases caused the destruction of embryos before the implantation, while in mice and rats they perished after embryo implantation. The comparative evaluation of genetic radiosensitivity in mice and Drosophila, determined by dominant lethals, shows mice are 5 to 10 times more radiosensitive. The frequency of dominant lethals in mice and Drosophila is proportional to the general size of the compared chromosomes. (R.V.J.)

15400 (A/AC.82/G/L.416) GENETICHESKAYA RADIOCHUVSTVITEL'NOST KLETOK RAZNYKH VIDOV MLEKOPITAYUSHCHIKH. (The Genetic Radio-Sensitivity of the Cells of Various Species of Mammals). Yu. Ya. Kerkis, G. M. Ronichevskaya, Yu. M. Rukavishnikov, and Yu. N. Naumenko (Adademiya Nauk S.S.S.R.). 1960. 16p.

The frequency of chromosome recombination is used as a criterion of small-dose radiation effects on spermatogonia and bone marrow cells in guinea pigs, white mice, white rats, and rabbits. The tabulated data indicate a difference in radiosensitivity: guinea pigs > white rats > mice > rabbits. The results of the tests are analyzed in view of genetic danger to humanity imposed by continuation of hydrogen explosions. (R.V.J.)

15401 (A/AC.82/G/L.417) EFFEKT MALYUKH DOZ RADIATSII NA KHROMOSOMNYE PERESTROIKI PRI OBLUCHENII KLETOK V KUL'TURAKH EMBRIONAL'NYKH TKANEI CHELOVEKA. (The Effects of Small Doses of Radiation on Chromosome Reorganizations During the Irradiation of Cells in Human Embryonic Tissue Cultures). N. P. Dubinin, Yu. Ya. Kerkis, and L. I. Lebedeva (Akademiya Nauk S.S.S.R.). 1960. 14p.

A quantitative evaluation of the effects of small radiation doses on heredity in humans was made by considering the amount of epithelium and fragments in anaphase and telophase mitosis in chromosome recombinations. Tissue cultures were prepared from 1.5- and 2-month old human embryos irradiated by 10, 25, and 50 r. The data show a higher radiosensitivity than expected. The frequency of spontaneous chromosome recombination was 1.5%; with an exposure to 1 r it was 0.25%. Hence, the frequency of natural chromosome mutation was doubled at about 6 r. (R.V.J.)

15402 (A/AC.82/G/L.418) VLIYANIE GENOTIPA ORGANIZMA NA CHUVSTVITEL'NOST YADERNOGO APPARATA K MALYM DOZAM IONIZIRUYSHCHEI RADIATSII. (The Influence of the Genotype of an Organism on the Sensitivity of the Nuclear Mechanism to Small Doses of Ionizing Radiation). Yu. Ya. Kerkis, G. M. Ronschevskaya, and Yu. N. Naumenko (Akademiya Nauk S.S.S.R.). 1960. 8p.

Tabulated data on the chromosome apparatus of bone marrow blood-building cell nuclei in various genotype guinea pigs show that albino pigs exposed to 0.5 r are about 4 times more radiosensitive than colored guinea pigs. (R.V.J.)

15403 (A/AC.82/G/L.421) SRAVNITEL'NOE IZUCHENIE EFFEKTIVNOSTI ODNOKRATNOGO I FRAKTSIONIROVANNOGO RENTGENOVSKOGO OBLUCHENIYA SEMENNIKOV MYSKI. (A Comparative Study of the Effectiveness of Single-dose and Fractionated X-Ray Irradiation of the Testes of Mice). N. I. Nuzhdin, N. I. Shapiro, M. D. Pomerantseva, and N. N. Kuznetsova (Akademiya Nauk S.S.S.R.). 1960. 20p.

Single and fractionated exposure to total doses from 100 to 400 r resulted in identical injury to testes in mice. The fractionation of 1600-r doses reduced the damage as compared to a single exposure. The reactions of genetic organs and other examined organs to fractionated 400-r doses varied; fractionation reduced the degree of damage to spleen, thymus, and peripheral blood. (R.V.J.)

15404 (A/AC.82/G/L.422) SRAVNITEL'NAYA RADIOCHUVSGVIGEL'NOST YAICHNIKOV OBEZ'YAN MACACA MULATTA I MYSHEI PRI OBLUCHENII RENTGENOVYMI LUCHAMI. (The Relative Radio-Sensitivity of the Ovaries of Macaca Mulatta Monkeys and Mice on Irradiation with X-Rays). Yu. S. Bocharov, E. V. Bocharova, and G. A. Mikheeva (Akademiya Nauk S.S.S.R.). 1960. 14p.

Ovaries in mice exhibit a much stronger radiosensitivity than ovaries in Macaca mulatta monkeys. Doses of 50 r have a sterilizing effect on ovaries in mice while in Macaca mulatta monkeys the initial depressing action on follicles begins at 100 r. Moreover, the disturbance of primozdial follicles in monkey ovaries is about 15 times weaker than in mice. Irradiation of monkey ovaries with 100 r stimulates the development of multilayer follicles and graaf bubbles. Due to the low radiosensitivity of Macaca monkey ovaries to sterilization by follicle depression, the radiogenetic danger is higher than in mice. (R.V.J.)

15405 (A/AC.82/G/L.424) TSITOGENETICHESKAYA RADIOCHUVSTVITEL'NOST POLOVYKH KLETOK OBEZ'YAN I MYSHEI NA UROVNE MALYKH I DRUGIKH DOZ. (The Cytogenetic Radio-Sensitivity of the Germ Cells of Monkeys and Mice at Small and Other Dose-Levels). M. A. Arsen'eva and G. G. Tinyakov (Akademiya Nauk S.S.S.R.). 1960. 16p.

A considerable increase in germ cell chromosome recombination was observed in male monkeys exposed to single whole-body irradiations of 10 to 400 r. Chromosome recombinations per roentgen in monkeys were much higher

an in mice (0.114 and 0.078% respectively). Cytological d histological analyses of testis indicate considerable sturbance in monkey spermatogenesis after exposure to r and temporary sterility 30 days after exposure to 00 r and 20 days after exposure to 400 r. The tests confirmed that the high genetic radiosensitivity of the germ ithelium in monkeys exceeds that of mice two to three id. (R.V.J.)

5406 (A/AC.82/G/L.425) TSITOLOGICHESKIE OKAZATEL'STVA FIZIOLOGICHESKOI ZASHCHISHCHENOSTI AUTOTETRAPLOIDOV GRECHIKHI (FAGOPRUM SCULENTUM MOENCH) OT DEISTVIYA IONIZIPUYUSHHEI RADIATSII. (Cytological Evidence of the Physiological Protection of Buckwheat Autotetraploids (Fagopyrum sculentum Monench) from the Effects of Ionizing Radiation). V. V. Sakharov, V. V. Mansurova, R. N. Platonova, nd V. K. Shcherbakov (Akademiya Nauk S.S.S.R.). 1960. 4p.

Evidence of an unique physiological protection against adiation, expressed by encumbered chromosome mutations, n buckwheat autotetraploid cells was observed during exosures to fast neutron, x rays, and γ radiation. Identical out somewhat weaker) physiological protection was also bserved in seeds stored for six months and a year after xposure. Both the autotetraploid and polyploid seeds exibited a regular sharp increase in the percentage of chroosome aberrations. However, the process was more prounced in the autotetraploid seeds. Consequently both types f buckwheat exhibited some mechanism that prevents poential and real breakage by ionizing radiation. The proective mechanisms are especially strong in autotetraploid uckwheat. (R.V.J.)

5407 (A/AC.82/G/L.426) RADIATSIONNOE PORAZHENIE RYB. (Radiation Damage in Fish). D. D. Romashov, V. N. Belyaeva, K. A. Golovinskaya, and A. A. Prokof'eva-Bel'govskaya (Akademiya Nauk S.S.S.R.). 1960. 18p.

The results of studies of radiation injuries in various types of fish at various stages of development are presented. General radiation injuries, the injury to the gonads, diploid radiation gynogenesis, and chronic radiation injuries to chromosomes in embryo development are discussed. (R.V.J.)

15408 (A/AC.82/G/L.427) OSOBENNOSTI INDUTSIROVANNOGO MUTATSIONNOGO PROTSESSA U MIKROORGANIZMOV. (Special Features of an Induced Mutation Process in Micro-Organisms). S. I. Alikhanyan, L. I. Erokhina, and S. I. Lyubinskaya (Akademiya Nauk S.S.S.R.). 1960. 16p.

The reactivation effects of visible light on cells inactivated by ultraviolet and on the mutation process induced by uv were studied with uv of 250 to 5000 erg/mm^{2}sec. The data confirm the effectiveness of light on the rate of mutation and other processes in the cell from the moment of irradiation until the development of genetic effects. Cell inactivation and genetic effects induced by uv are independent processes. Both inactivation and mutagenesis exhibit reversible and irreversible processes. About 25% of the mutations did not respond to "restoration" by light. The data also showed organisms exhibit no acclimatization to radiation inactivation or to its genetic effects. (R.V.J.)

15409 (AD-243640) EFFECTS OF IRRADIATION AND STRESS ON ADRENOCORTICAL STEROIDOGENESIS. Final Report, July 30, 1953–June 30, 1960. Robert S. Cox, Jr., Ward A. Soanes, and John R. Maher (Letterman General Hospital, San Francisco). 15p.

Nine cases of testicular tumor were treated by therapeutic doses of x radiation to include the region of the adrenals. L7-ketosteroid and 17-hydroxysteroid analyses were performed before, during, and after this irradiation. Adrenal steroidogenesis was evaluated by the response of the adrenal to 40 units of ACTH administered intravenously over a ten hour period on one day, or on two successive days. Most patients showed enhancement of adrenal cortical steroidogenesis during or immediately following irradiation presumably reflecting the general adaptation syndrome. The data indicated that patients receiving more than 2000 r tissue dose of x radiation showed increased steroidogenesis during irradiation in response to the one day ACTH stimulation test. Less than 2000 r produces no significant stimulation nor subsequent impairment. Doses of 2000 to 3000 r produce transient stimulation followed by loss of adrenal cortical reserve as shown by the two day ACTH stimulation test, while doses in excess of 3000 r produce subsequent impairment as manifested by the one day ACTH stimulation test. Doses in excess of 3500 r do not appear to affect adrenal steroidogenesis under nonstress conditions, but markedly impair their ability to respond to stress. Data on patients receiving x radiation through portals including the adrenal and through other portals suggest that the primary effect is due to direct adrenal irradiation, but that generalized systemic toxicity may play a role. Patients receiving 3500 r tissue dose to the adrenals show no histologic changes of the adrenal cortex. (auth)

15410 (QMFCIAF-28-60) MODIFICATION OF THE RESPONSE OF GUINEA PIGS TO WHOLE-BODY IRRADIATION BY DIETARY SUPPLEMENTATION WITH RAW PLANT MATERIALS. Interim Report. Harry Spector and Doris Howes Calloway (Quartermaster Food and Container Inst. for the Armed Forces, Chicago). Aug. 1960. 20p. (AD-243749).

Exposure to 400 r of whole-body x radiation resulted in 99% mortality in 10 to 15 days of young male guinea pigs fed basal diet of bran and oats plus ascorbic acid. Supplementation with green plant materials, notably from the Brassicaceae family, for 2 weeks before irradiation and during 30 days after irradiation reduced mortality to 46%. Other categories of foods showed marginal or no beneficial effects. Prefeeding of cabbage to time of radiation exposure delayed onset of death; post-irradiation supplementation yielded a lower total mortality. These effects were additive. Supplements which were beneficial promoted improved growth, but superior weight gain did not guarantee decreased radiosensitivity. Supplements providing vitamin A uniformly extended survival time but did not consistently influence mortality. (auth)

15411 (TID-12373) PRENATAL X-RAY AND CHILDHOOD NEOPLASIA. Interim Report, June 1, 1959–April 1, 1961. (Harvard Univ., Boston. School of Public Health). Contract AT(30-1)-2369. 4p.

Data are reviewed on the incidence of cancer mortality among 547,701 infants discharged alive from 30 maternity hospitals between 1947 and 1959. The cancer patients all died before January 1, 1959. The distribution of childhood neoplasia was classified according to frequency of prenatal abdominal and pelvic x-ray exposure of the mother, and results were analyzed statistically. A small but statistically significant increase in childhood neoplasia was found in the offspring of irradiated mothers. Results are discussed. (C.H.)

15412 (TID-12388) SUBSTANCES RELEASED FROM THE SKIN AND METHODS OF INHIBITING SKIN LESIONS FOLLOWING BETA RADIATION OF THE SKIN (INCLUDING

POLYOXYETHYLENE ETHERS). Final Report. Sol Roy Rosenthal (Illinois. Univ., Chicago. [Coll. of Medicine]). 1960. Contract AT(11-1)-706. 31p.

Results are reported from a series of studies on the response of skin to β-ray exposure. Sr^{90} applicators which delivered total doses of 3000 to 5500 rep were applied to the shaven skin of rats. Data are included from studies on the effects of injections of spleen homogenates and polyoxyethylene ethers on the production of skin lesions following β exposure and the effects of β exposure of the skin on weight of the rats. Results of serologic studies indicated that antigen-antibody complexes appear in the blood of β-irradiated rats before local lesions are manifest. Identification of these complexes may serve as a method of early diagnosis. (C.H.)

15413 (TID-12390) EFFECT OF GAMMA RADIATION ON BIOLOGICAL PROPERTIES RELATED TO THE STRUCTURE OF SELECTED ANIMAL VIRUSES. Technical Progress Report, May 15, 1960–February 15, 1961. (Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research and Iowa State Univ. of Science and Technology, Ames. Veterinary Medical Research Inst.). Feb. 15, 1961. Contract AT(11-1)-902. 41p.

Work is reported on an effort to establish the relative differences in resistance to the stress of heat by strains of Newcastle disease virus (NDV). Certain measures are described which were undertaken to make the Co^{60} irradiation facility and its operation comply with specific recommendations of the Division of Licensing and Regulation of the AEC. (C.H.)

15414 (UCLA-472) X-IRRADIATION PROTECTION STUDIES. II. MODIFICATION OF THE RADIATION SYNDROME IN FEMALE DAL-SWISS MICE BY AET AND 5-HT. James L. Leitch (California. Univ., Los Angeles. School of Medicine). Mar. 29, 1961. Contract AT(04-1)-GEN-12. 18p.

To evaluate the efficiency of aminoethylisothiuronium bromide-HBr (AET) and 5-hydroxytryptamine (5-HT) for the modification of the radiation syndrome, female DAL-Swiss mice were exposed to doses of 460 to 1200 r of whole-body x irradiation. The survival time curves were analyzed by the graphical method of Litchfield. The dose rate was also varied in one experiment. It has been shown that a combined intraperitoneal dose of 10 μM AET plus 1 μM 5-HT prior to a single whole-body 460 r x ray exposure given in a 35 minute period decreased the total cumulative per cent mortality and increased the survival time to a greater extent than did either compound when used alone. This dose of AET + 5-HT increased the ST_{50} time from 7.2 days to 40 days and decreased the 60-day mortality from 95.8 to 48.6%, respectively. A dose of 1200 r x rays was required to reduce the ST_{50} time of treated mice from 40 to 6.6 days, a value approximately equal to that for untreated mice receiving only 460 r. If the 460 r whole-body x-ray dose was given in approximately 7.5 hours no protection could be demonstrated. (auth)

15415 (UR-583) URINARY TAURINE EXCRETION AND THE PARTITION OF SULFUR IN FOUR SPECIES OF MAMMALS AFTER WHOLE BODY X-IRRADIATION. Charles R. Angel and Thomas R. Noonan (Rochester, N. Y. Univ. Atomic Energy Project). Dec. 9, 1960. Contract W-7401-eng-49. 15p.

Four species of mammals were exposed to physically equivalent doses of whole-body x irradiation. Taurine and total sulfur were measured for several days prior and for at least seven days post-irradiation. Taurine excretion after irradiation was found to be a species dependent phenomena and correlated with total sulfur changes only in the rat. (auth)

15416 (WADD-TR-60-395) INFLUENCE OF AET UPON THE UPTAKE OF IRON-59 BY THE RED BLOOD CELLS OF GAMMA-IRRADIATED RATS. R. L. Preston and A. P. Raun (Wright Air Development Div. Biomedical Lab., Wright Patterson AFB, Ohio). May 1960. 15p. (AD-246348).

Four experiments were conducted to determine the effects of AET (2-aminoethylisothiouronium-bromide) injections on the erythropoietic ability of rats following acute gamma irradiation. Incorporation of Fe^{59} into newly formed red blood cells was used as the criterion of erythropoietic rate. When AET was injected intraperitoneally 15 to 20 min before radiation exposure, little difference resulted in the depression of Fe^{59} uptake 1 to 4 days after irradiation between the nonprotected and AET-protected rats. AET alone had no effect upon the incorporation of Fe^{59}. Rats maintained for 31 days after irradiation, however, showed a faster recovery of erythropoiesis when protected with AET. Faster rates of erythropoiesis occurred in the irradiated rats than in the controls 15 to 18 days after radiation exposure. Those protected with AET incorporated Fe^{59} into newly formed red blood cells at a rate equal to that of the nonirradiated rats 2 to 3 days earlier than did nonprotected rats. (auth)

15417 (JPRS-7886(p.15-20) STUDY OF THE THERAPEUTIC EFFECT OF BETATRON RADIATION FOR MALIGNANT TUMORS OF THE GENITALIA. G. T. Ishchenko. Translated from Med. Radiol., 5: No. 10, 14-18(1960).

After a brief description of a study of the therapeutic effects of betatron bremsstrahlung on spontaneous sarcoma in dogs, a detailed report of an investigation of the treatment of malignant tumors in the genitalia of women is given. A positiometer for locating accurately the tumor, determining its depth, and aiming the radiation beam is described. Of 23 patients treated, 17 showed absence of malignant elements. From the study it was found that the parametrial and pelvic tissue should be irradiated as well as the pelvic lymph nodes. A rectangular collimator is preferred. The dose should reach 15 to 20 kr with two exposures daily of a total of 600 r. The dose rate should be 60 to 100 r per min. One continuous course should be used. (T.R.H.)

15418 (JPRS-7886(p.32-5)) THE INFLUENCE OF IRRADIATION ON THE LYSIS OF THE BONE MARROW CELLS BY THE AQUEOUS HUMOR. Yu. M. Zaretskaya. Translated from Med. Radiol., 5: No. 10, 25-8(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 5915.

15419 (JPRS-7886(p.85-93)) SOME DATA CONCERNING RADIATION EFFECTS WITH A HIGH DOSE RATE. L. B. Koznova and V. G. Khrushchev. Translated from Med. Radiol., 5: No. 10, 61-7(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 5920.

15420 (JPRS-7886(p.120-1)) THE EFFECT OF X-RAYS ON THE IRON CONTENT IN THE FERRITIN AND HEMOSIDERIN FRACTIONS OF MOUSE LIVER. G. V. Voskoboinikov (Voskoboynikov). Translated from Med. Radiol., 5: No. 10, 81-2(1960).

A study was made of the effects of x rays on the stores of readily hydrolyzed non-hemin Fe in mouse tissues irradiated at 500 r. The results show that the accumulation of Fe in the livers of mice during the first two weeks after their irradiation occurs chiefly because of its intake from the gastrointestinal tract. The inhibition of hematopoiesis, the increase in intestinal permeability, hemorrhage, and

estruction of blood cells also contribute to increased Fe eposition. (T.R.H.)

5421 EFFECT OF THERMAL NEUTRONS ON CENTRAL NERVOUS SYSTEM. Apparent Tolerance of Central Nervous System Structures in Man. L. E. Farr, W. G. Calvo, W. Haymaker, S. W. Lippincott, Y. L. Yamamoto, and E. E. Stickley (Brookhaven National Lab., Upton, N. Y.). A.M.A. Arch. Neurol., 4: 246-57(Mar. 1961).

In the histological studies of serial whole brain sections from 17 patients treated by neutron capture therapy for intracranial neoplasms, no changes consistent and attributable to exposure with thermal neutrons were found in the nervous tissue. A maximum neutron exposure of 1.73×10^{12} thermal neutrons per square centimeter occurred over a 200-second interval. One additional patient receiving only a thermal neutron exposure to the brain surface of approximately 4.7×10^{11} thermal neutrons per square centimeter showed no histological changes attributable to the neutron exposure in either neoplastic or normal brain tissue. The findings are similar in other patients observed up to intervals of 18 months after neutron capture therapy. The difficulties in transposing the observed neutron exposure intensities into rad units is discussed. (auth)

15422 BLOOD VESSEL CHANGES FOLLOWING LOCAL IRRADIATION OF THE BRAIN WITH HIGH-ENERGY PROTONS. Börje Larsson (Univ. of Uppsala). Acta Soc. Med. Upsaliensis, 65: No. 1-2, 61-71(1960). (In English)

The cerebral cortex and thalamus in the brain of the rat were locally irradiated with a narrow beam of high-energy protons. The developing radiolesion was studied, especial attention being paid to disturbances of capillary function. A semi-quantitative comparison between effects at different times after irradiation with different doses in the region 10 to 40 krad was attempted. Three types of changes observed included: impairment of capillary circulation, increase of permeability of trypan blue through the blood-brain barrier system, and necrosis. Depending on the radiation dose, there were periods of 1 to 14 days after irradiation during which no changes were found. The first effects observed were impaired capillary circulation and damage to the blood-brain barrier system for trypan blue. The latter type of changes was always accompanied or succeeded by visible degeneration of nerve cells leading to necrosis. Circulatory disturbances thus seem to precede the trypan blue staining of irradiated brain tissue. As a matter of further discussion a hypothetical mechanism in consistency with observation and modern concepts of the constitution of the blood-brain barrier system is outlined. The mechanisms involved in the rapid development of lesions might be different from those involved in the production of late delayed radionecrosis. The results show that the detection of changes in the blood-brain barrier system with suitable dyes or radioactive compounds may be used as a means of early diagnosis of the radiolesion. (auth)

15423 SYNTHESIS OF DNA IN X-IRRADIATED ESCHERICHIA COLI B. B. Mitetić, Ž. Kućan, and Lj. Zajec (Inst. "Ruder Boskovic," Zagreb). Biochem. Biophys. Research Communs., 4: 343-7(Apr. 7, 1961).

The effects of x radiation on the synthesis of nucleic acids were studied in Escherichia coli grown in a glucose mineral medium. The growth of bacteria irradiated with 16,000 r was observed to be slowed down when compared with controls. The synthesis of ribonucleic acid (RNA) took place in the irradiated cells without delay and at the same rate as growth but great changes were observed in the synthesis of desoxyribonucleic acids (DNA). The biosynthetic patterns were observed to depend on the method of chemical fractionation. After exposure to doses of 1000 r x radiation the growth and synthesis of both RNA and DNA were almost identical as in nonirradiated control cultures. Results are compared with published data. (C.H.)

15424 EFFECT OF CHLORAMPHENICOL ON THE BIOSYNTHESIS OF DNA IN X-IRRADIATED ESCHERICHIA COLI B. B. Mitetic, Z. Kucan, M. Drakulic, and Lj. Zajec (Inst. "Ruder Bodkovic," Zagreb). Biochem. Biophys. Research Communs., 4: 348-52(Apr. 7, 1961).

Escherichia coli grown in a mineral medium were exposed to various doses of x radiation. Chloramphenicol was added to half the irradiated suspension at a concentration of 10 μg/ml. Desoxyribonucleic acid (DNA) levels were determined after chemical fractionation of the cells. Growth was observed to stop in both control and irradiated cultures after the addition of chloramphenicol. The snythesis of ribonucleic acid (RNA) continued, but was significantly inhibited in samples exposed to 16,000 r. Doses of 1000 r had no measurable effect on DNA synthesis and the addition of chloramphenicol did not effect the degradation of DNA or the inhibition of its biosynthesis. It is concluded that both the degradation of DNA and the effect of chloramphenicol on DNA metabolism after x irradiation depend on the degree to which the mechanism of DNA biosynthesis is damaged. (C.H.)

15425 RADIATION INHIBITION OF AMINO ACID UPTAKE BY ESCHERICHIA COLI. E. S. Kempner and E. C. Pollard (Yale Univ., New Haven). Biophys. J., 1: 265-77 (Mar. 1961).

The inhibition of macromolecular synthesis in Escherichia coli by ionizing radiation has been investigated. The survival of the ability to incorporate arginine, leucine, isoleucine, histidine, uracil, and glucose after various doses of gamma radiation, deuteron and α particle bombardment has been measured. All amino acids are incorporated by processes which show the same radiation sensitivity. The sensitivity of uracil corresponds to a volume which is roughly spherical, of radius about 160A, whereas the amino acids possess sensitive regions which are long and thin in character. The uptake of glucose is concerned with a smaller, roughly spherical unit. The possible identification of the radiation-sensitive targets with cellular constituents is discussed. The long thin character observed for amino acids suggests that the sensitive region affected by radiation is an unfolded form of a ribosome, or alternatively a long nucleic acid molecule. For uracil the sensitive region fits with a 70S ribosome, while for glucose a smaller particle would fit the data. (auth)

15426 RELATION BETWEEN MOLECULAR MORPHOLOGY OF MACROMOLECULES OF DEOXYRIBONUCLEIC ACID AND THEIR RADIOSENSITIVITY (PROBLEM OF THE RADIOSENSITIVE AND RADIORESISTANT FORMS OF DNA). P. I. Tseitlin, D. M. Spitkovskii, and N. P. Riabchenko (Inst. of Experimental Biology, Academy of Medical Sciences, Moscow). Biophysics (U.S.S.R.)(English Translation), 5: No. 4, 454-9(1960).

The presence of radioresistant and radiosensitive forms of DNA associated with features of the configuration of the latter was demonstrated. (auth)

15427 ULTRAVIOLET FLUORESCENCE OF CERTAIN ANIMAL ORGANS AND ITS CHANGE ON IRRADIATION. Sh. D. Khan-Magometova, A. V. Gutkina, M. N. Meisel, L. S. Agroskin, and N. V. Korolev (Inst. of Biological Physics, Academy of Sciences, Moscow). Biophysics (U.S.S.R.) (English Translation), 5: No. 4, 509-13(1960).

After whole-body x irradiation of animals there was a considerable rise in the intensity of ultraviolet fluorescence

of radiosensitive organs, such as bone marrow, spleen, lymph nodes, and blood plasma. The intensity of fluorescence of organs resistant to radiation did not change appreciably. (auth)

15428 MECHANISM OF EARLY RADIATION DAMAGE OF BONE MARROW. S. Ia. Rapoport and S. M. Gasanova (Inst. of Biological Physics, Academy of Sciences, Moscow). Biophysics (U.S.S.R.)(English Translation), 5: No. 4, 517-24(1960).

Early radiation damage to the bone marrow, detected by the method of fluorescence microscopy, develops only with direct irradiation. Early damage to the bone marrow on whole-body irradiation of the animal is much more marked than on irradiation of one limb. Injection of procaine or atropine before or after whole-body irradiation of the animal lessens the damage to the bone marrow and eliminates the difference usually observed on whole-body irradiation and irradiation of one limb. Injection of these substances does not effect the response of the bone marrow on irradiation of one limb. Disturbance in the nerve links of the bone marrow or exclusion of the receptors of the peritoneal cavity before whole-body irradiation of the animal also removes the difference in damage on whole-body irradiation and irradiation of one limb. The findings indicate that early damage to the bone marrow on whole-body irradiation is due both to the direct effect of x rays on the bone marrow and to a neuro-reflex reaction, the initial link of which is stimulation of receptors of the peritoneal cavity. (auth)

15429 TRANSLOCATED EFFECT OF IONIZING RADIATION IN PLANTS. L. M. Kriukova and A. M. Kuzin (Inst. of Biological Physics, Academy of Sciences, Moscow). Biophysics (U.S.S.R.)(English Translation), 5, No. 4, 513-16(1960).

It is demonstrated that with local irradiation of plant leaves, inhibitors of cell division are formed or released from a bound state. The inhibitor is translocated from the irradiated leaves to the growing points and can be detected 4 hr after irradiation. A distinct effect of the inhibitor is manifest after 24 hr. The inhibitor can be extracted from the irradiated leaves and is of a non-protein nature. In low concentrations this substance considerably inhibits mitosis in the root tips. (auth)

15430 DIPLOID RADIATION GYNOGENESIS IN FISH. D. D. Romashov, K. A. Golovinskaia, V. N. Beliayeva, E. D. Bakulina, G. L. Pokrovskaia, and N. B. Cherfas (Inst. of Biological Physics, Academy of Sciences, Moscow and Inst. of Pond Pisciculture of the R.S.F.S.R., Moscow). Biophysics (U.S.S.R.)(English Translation), 5: No. 4, 524-32(1960).

In experiments with groundling and carp, it was established that x irradiation of the sperms and fertilization by them of normal spawn gives a degree of damage to the developing embryos which increases as the radiation dose rises from 2000 to 6000 r. Beyond this limit the damage is lessened and despite an increase in the dose, a gradual return to normal is observed in terms of mortality and percentage of chromosome breaks. Further, although the degree of deformation diminishes, the percentage of deformed embryos remains at a constant extremely high level. Single normal individuals make their appearance at very high doses of radiation ranging from 100,000 to 200,000 r. The picture of the so-called Hertwing effect is observed in these phenomena. Experiments with Prussion carp (Carassius auratus gibelio) of a unisexual line showed that the ability to undergo natural gynogenesis enables the spawn of this fish to withstand the destructive action of sperm exposed to ionizing radiations irrespective of the size of the dose employed. (auth)

15431 THRESHOLD REACTIVITY OF VARIOUS REGIONS OF THE HUMAN RETINA TO X-IRRADIATION. G. K. Gurtovoi and Ye. O. Burdianskaia (Inst. of Biological Physics, Academy of Science, Moscow and Helmholz Inst. for Diseases of the Eyes, Moscow). Biophysics (U.S.S.R.) (English Translation), 5: No. 4, 538-43(1960).

When x radiation is delivered to the whole retina of the normal eye the substrate in which the primary impulse develops, leading to sensation of light with the threshold dose, is the peripheral rod and not the central cone apparatus. In this case the threshold is a dose of about 1 mr. The region of the retina of radius 10 to 30° has a higher threshold than the whole normal retina. For this region the threshold dose is of the order of 150 mr. For marked degrees of exclusion of both rod and cone apparatuses a dose of 2 r does not produce a sensation of light, i.e., is subthreshold. The findings may be utilized in clinical investigations of the retina in the case of opaque optical media. (auth)

15432 SOME RADIOBIOLOGICAL CONSIDERATIONS IN RADIOTHERAPY. L. G. Lajtha and R. Oliver (Churchill Hospital, Oxford). Brit. J. Radiol., 34: 252-7(Apr. 1961).

The theoretical implications of the x-ray dose response curves for reproductive integrity of mammalian cells are discussed, and a calculation of the accumulated effective dose under continuous irradiation with different dose rates is given. (auth)

15433 A COMPARISON OF MUTATION INDUCED BY ACUTE X AND CHRONIC GAMMA IRRADIATION IN MICE. Rita J. S. Phillips (Medical Research Council, Radiobiological Research Unit, Harwell, Berks, Eng.). Brit. J. Radiol., 34: 261-4(Apr. 1961).

An experiment is described in which male mice received, in one group, an x-ray dose of 600 r given at a high dose-rate and, in a second group, a dose of 600 r of Co^{60} γ rays given at a low dose-rate. Spermatogonial specific locus mutation rates were studied. The induced mutation rate was significantly lower in the chronically irradiated group. A significant difference in the mutability of the d-locus was found between experiments carried out at Harwell and the acute x-ray experiments reported by Russell and Russell (1959). (auth)

15434 DIRECT ACTION OF X RAYS ON THE SPLEEN OF THE CHICKEN EMBRYO DURING MYELOGENESIS. Raoul Michel May and Francoise Lahille (Faculté des Sciences, Paris). Compt. rend., 252: 1221-3(Feb. 20, 1961). (In French)

The effect of x rays on the spleen during its myelogenesis was studied in chicken embryos exposed to 200, 400, 600, and 800 r on the 11th day of incubation. The results showed that the hemopoiesis is strongly affected even by 200 r. The cell progenitors show lesions with 400 r. The lymphocytic line is the most sensitive, decreasing in percentage from 200 r. The erythrocytic line is injured only by a dose of 600 r. However, even the lesions produced by a dose of 800 r do not appear definitive. Hemopoiesis recovers toward the 16th day of incubation for the lymphocytic and granulocytic lines, but the erythrocytic line is still deficient. (J.S.R.)

15435 RADIOMIMETIC EFFECT OF THE CHELATED FERROUS ION. Alain Paquelier, Andre Cier, Claude Mouriquand, Jean-Marie Clement, and Claude Nofre (Services de Santé, Lyon). Compt. rend., 252: 1227-9(Feb. 20, 1961). (In French)

The hematological and histological phenomena after injection of ferrous ethylenediaminetetraacetate (EDTA) in mice are similar to the effect caused by ionizing radiation. These results are in agreement with the hypothesis of a

radiomimetic activity of self-oxidizable metallic chelates. (tr-auth)

15436 CYTOPHOTOMETRIC AND HISTOAUTORADIOGRAPHIC STUDY OF THE EFFECTS OF X RAYS ON THE DESOXYRIBONUCLEIC ACIDS OF CELLS LIVING IN CULTURE. C. M. A. Kuyper, S. Liébecq-Hutter, and S. Chevremont-Comhaire (Universite, Liège). Compt. rend. soc. biol., 154: 1661-4(1960). (In French)

A study was made of the desoxyribonucleic acid (DNA) of in vitro fibroblasts and myoblasts of chicken embryos by determining the DNA by cytophotometry and following the incorporation of tritiated thymidine the first few hours after irradiation. The cultures received 400 r of x radiation. Immediately after irradiation no difference can be detected in the DNA of irradiated and sample cells. The tetraploid value and the intermediary values between diploid and tetraploid increase. The tetraploid value begins to decrease after 4 hr, but there is an abnormally high percentage of the intermediary values. To some samples tritiated thymidine was added either immediately before or after the irradiation. The first two hours after irradiation the percentage of marked nuclei is much higher than that of the samples. It was noted that the intensity of marking is less in the irradiated cultures than in the sample couples. The increase of the incorporation of tritiated thymidine coincides with the augmentation of tetraploid and higher values. (J.S.R.)

15437 THE EFFECT OF TOTAL X RADIATION ON THE REACTIVITY OF TISSUE SULPHYDRYL GROUPS. T. A. Speranskya and L. I. Korchak (Severtsev Inst. of Animal Morphology, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 136: 1468-70(Feb. 21, 1961). (In Russian)

Effects of x radiation on the reactivity of the sulphydryl group were studied in 18 to 20-g white mice exposed to whole-body, single dose, x-irradiations of 700 r at 50 r/min. Tissue homogenates of spleen, testes, and brain and whole blood diluted with distilled water (1 : 40) were tested. The results of amperometric titration of the SH group in homogenates from irradiated and non-irradiated animals show that the weakly-reacting SH groups of spleen and testes change after exposure. Incubation of the homogenate at 2° for 2 hours is not followed by an obvious reduction in the content of SH. The inactivation rates of SH in brain and blood homogenates were identical in irradiated and control mice. The data are still incomplete and demand further investigations. (R.V.J.)

15438 REGENERATION AND DIVISION OF BLEPHARISMA FOLLOWING X-IRRADIATION. A. C. Giese and Molly W. Lusignan (Stanford Univ., Calif.). Exptl. Cell Research, 23: 238-50(Mar. 1961).

The regeneration of irradiated fragments of Blepharisma undulans var. americanus, is delayed by x irradiation, the delay being greater the larger the dose, the effect increasing at a rate greater than linear. Only the posterior fragments were used in these experiments and the reappearance of the food vacuoles was taken as the end point of reformation of functional mouth parts. The delay in regeneration of x-irradiated fragments is parallel to a delay in macronuclear reorganization which always accompanies regeneration. Subsequent division of the regenerated fragments is also delayed similarly to delay of regeneration. Decreasing the oxygen tension by flushing the culture with nitrogen decreases the effectiveness of a given dose of radiations but does not alter the qualitative nature of the results. Fragments irradiated in pure oxygen were no more retarded than those irradiated in air. Fragments of starved Blepharisma proved to be more susceptible to x rays than fragments of well-fed animals, as indicated by more prolonged regeneration-delay as well as division delay. Again, only a quantitative difference in susceptibility to x rays between experiments carried out in air and in nitrogen was observed. The delay in regeneration produced by x rays is greatest when the irradiation occurs three hours after cutting, indicating a period of radiation sensitivity at this time. When the fragments are irradiated four and a half hours after cutting, regeneration is delayed very much less. The delay of division of the regenerated fragments is much the same regardless of the time after cutting when irradiation occurs. Regeneration of fragments cut after x irradiation is most delayed when the animals are cut soon after irradiation; the delay decreases progressively until in four to six hours after irradiation the delay is very small and in eight to twelve hours almost nil. Cutting the irradiated Blepharisma was found to accelerate recovery from division-retarding effects of x rays. (auth)

15439 LATENT RADIATION-INHIBITION AND RECOVERY OF MITOTIC ACTIVITY IN MOUSE KIDNEY. L. J. Cole and V. J. Rosen, Jr. (Naval Radiological Defense Lab., San Francisco). Exptl. Cell Research, 23: 416-18(Mar. 1961).

Young adult hybrid mice were given an LD_{100} of 250 Kvp x rays (870 r) in a single whole-body exposure. This was followed within a few hours by an intravenous injection of a suspension of bone marrow cells derived from normal mice of the same strain, to enable the mice to survive the otherwise lethal irradiation. Groups of these mice were then subjected to unilateral nephrectomy at 2 weeks, 4 weeks, and 9 weeks post-irradiation. The remaining kidney was extirpated 48 hours post-nephrectomy, and the mitotic activity determined on Feulgen stained kidney sections. Mitotic activity was expressed as number of mitoses per 50 high power fields. The results are tabulated. It is evident that exposure of the intact kidney to an x ray dose of 870 r elicits a latent injury which is expressed as an incapacity to initiate cell division following a stimulus to mitosis applied 2 weeks after irradiation. Recovery from this latent radiation damage is evident by 4 weeks post-irradiation, when the mitotic activity following unilateral nephrectomy is greatly increased over 2 weeks levels, and indeed, approaches the values observed in non-irradiated controls subjected to unilateral nephrectomy. Further evidence for recovery from the radiation-induced latent injury to mitotic capability of the kidney, is seen in the data on kidneys induced to regenerate 9 weeks after irradiation. Here, an actual overshoot in mitotic activity, as compared with the non-irradiated nephrectomized controls, can be observed. Reaction mechanisms involved are discussed. (C.H.)

15440 INFLUENCE OF X-RAY TREATMENTS APPLIED TO SEED ON MORPHOLOGICAL CHARACTERS IN WHEAT. R. E. Scossiroli (Universita, Pavia, Italy), D. Palenzona, and B. Rusmini. Genet. agrar., 251-82 (1960). (CNEN-24). (In Italian)

Preliminary results are presented from a study on the effects of x radiation on the induction of mutations in polygenic systems following exposure of seed. Data are summarized on the effects of a dose of 10000 r on the seed of T. durum and T. vulgare as observed in R_1 plants. A different response of different heads to the same treatment was observed. (C.H.)

15441 TRANSPLANTATION OF ANTIBODY-FORMING CELLS IN LETHALLY IRRADIATED MICE. N. Gengozian,

T. Makinodan, and I. C. Shekarchi (Oak Ridge National Lab., Tenn.). J. Immunol., 86: 113-22(Feb. 1961).

A comprehensive study of the relative contribution of normal versus presensitized bone marrow or spleen tissue to the antibody-forming mechanisms of lethally irradiated mice was made. Bone marrow cells transplanted into the irradiated animals showed definite antibody-forming potential when marrow was obtained from presensitized donors but lacked this capacity if normal, nonsensitized donors were used. In contrast, both normal and presensitized spleen cells transplanted into the irradiated host were able to initiate an immune response to the test antigen. The marked efficiency of the spleen over the bone marrow was indicated by the ability of 12×10^6 presensitized spleen cells to produce agglutinins in amounts comparable to that observed in normal mice undergoing a secondary type of response. Different presensitization procedures of the donors also revealed differences in the efficiency of the transplanted hematopoietic cells to produce antibody in the irradiated host. The increased antibody-forming potential of both bone marrow and spleen cells from presensitized donors was demonstrated in two in vivo biologic tests. A relative decrease was observed in the ability of marrow and spleen cells from presensitized donors to protect lethally irradiated isologous mice, and in a homologous transfer of cells, marrow and spleen cells from donors sensitized to the homologous recipient showed a detrimental effect when transplanted into lethally irradiated homologous mice. (auth)

15442 REGRESSION OF GRAFTED BONE MARROW IN HOMOLOGOUS IRRADIATED MOUSE CHIMERAS. Raymond A. Popp (Oak Ridge National Lab., Tenn.). J. Natl. Cancer Inst., 26: 629-40(Mar. 1961).

Lethally irradiated mice receiving injections of bone marrow exhibited only a transitory production of graft-derived erythrocytes, the tendency for regression of the grafted marrow apparently varying with the x-ray dose and number of marrow cells infused. Judged on the basis of circulating erythrocytes, the grafted marrow persisted longer and regressions occurred later and less frequently in lethally than in midlethally irradiated recipients of 75×10^6 cells. Regression of grafted 101 marrow was not observed in lethally irradiated mice, though such marrow did regress in midlethally irradiated hybrid recipients. The delayed mortality of the irradiated recipients was not consistently correlated with persistence or regression of the grafted marrow. The regression of grafted parental marrow noted under these conditions cannot as yet be conclusively explained, but might have resulted from an immunological rejection of the grafted cells. Genetic mechanisms for such a phenomenon are discussed, along with other mechanisms that might favor the selective growth of autologous hematopoietic cells. (auth)

15443 TUMORS OF THE CENTRAL NERVOUS SYSTEM OF RATS: WITH REPORT OF TWO TUMORS OF THE SPINAL CORD AND COMMENTS ON POSTERIOR PARALYSIS. J. R. M. Innes and G. Borner (Brookhaven National Lab., Upton, N. Y.). J. Natl. Cancer Inst., 26: 719-25 (Mar. 1961). (BNL-4928)

The topic of tumors of the central nervous system of rats is reviewed. An ependymoma and a sarcoma of the spinal cord are reported. Comments are made on the clinical problem of posterior paralysis in rats and the difficulties in neurologic diagnosis in rodents. (auth)

15444 CHANGES IN DENSITY OF BLOOD SERUM AFTER TOTAL-BODY IRRADIATION. Z. Dienstbier and M. Rakovič (Charles Univ., Prague). Nature, 190: 98-9 (Apr. 1, 1961).

The blood serum from rats exposed to a single whole-body dose of 600 r x radiation showed an increase in density when compared with serum from control rats. A slight, but not statistically significant, difference was found in the density of the blood serum from irradiated rats and rats exposed to thermal stress. Possible causes affecting post-irradiation increase in blood serum density are discussed. (C.H.)

15445 HAEMAGGLUTININ PRODUCTION IN PREIMMUNIZED MICE EXPOSED TO CONTINUOUS γ-RADIATION. J. P. M. Bensted (Inst. of Cancer Research, Belmont, Surrey, Eng.). Nature, 190: 99-100(Apr. 1, 1961).

Hemagglutin titers were maintained at normal levels in pre-immunized mice exposed continuously to a daily dose of 84 rad γ radiation. Higher titers were observed during the early post-irradiation period. The maintenance of normal hemagglutinin titers during continuous irradiation is interpreted as an indication that antibody-producing mechanisms are not seriously disturbed despite the accumulation of relatively large doses of radiation. It is suggested that some relatively radioresistant cell belonging to the reticulo-endothelial system is responsible for antibody production. (C.H.)

15446 THE EFFECT OF SINGLE AND FRACTIONATED X RADIATION ON HUMAN CELLS IN VITRO. B. Dietel-Mauersberger and E. Edlinger (Humboldt-Universität, Berlin). Naturwissenschaften, 48: 105-6(1961). (In German)

The effect of single and fractionated x radiation on the survival of a fibroblast clon of Chang's human liver strain was investigated. The cells were exposed to a dose rate of 145 r/min. The survival curve plotted as a function of the dose is an exponential curve. LD_0 lies at 165 r. The results show that single doses are additive. A total dose of 300 r, administered in two doses of 150 r each, gave results which coincide with those obtained from a single dose of 300 r. (J.S.R.)

15447 CEREBRAL DAMAGES AFTER IRRADIATION. EEG TRACINGS AFTER X-RAYS EPILATION OF THE HEAD IN MYCOSIS. Jozef Lipski. Polski Tygod. Lekar., 14: No. 50, 7p.(1959). (In Polish)

Electroencephalography was performed in 20 children suffering from mycosis of the head. The curves were traced before the x-ray treatment, then several hours, one day, and three months after the treatment. Fifteen children were irradiated by the four—areas method, the doses being 400 to 420 r for two areas daily. In 5 cases the children received 50 r on four areas daily during 8 days. No pathologic changes in the EEG curves were found. (auth)

15448 RADIATION LESIONS OF BONES FOLLOWING TREATMENT OF MALIGNANT NEOPLASMS OF THE FEMALE GENITAL TRACT. K. V. Shimanovskaya (Shimanovskaia) (Central Inst. of Medical Radiology, Leningrad). Problems of Oncol. (U.S.S.R.) (English Translation), 6: 1439-47(1960).

Case histories are presented for three female patients in whom changes in the neck of the femur were observed after irradiation of the pelvis minor for carcinoma of the reproductive system. Conclusions are presented based on these cases and a survey of 200 cases described in the literature. (C.H.)

15449 EFFECT OF GAMMA IRRADIATION AND AET ON RAT BLOOD CHOLINESTERASE. Martin W. Williams, Roger D. Baker, and R. Wade Covill (Univ. of Vermont Coll. of Medicine, Burlington). Proc. Soc. Exptl. Biol. Med., 106: 603-5(Mar. 1961).

Whole-body gamma irradiation in the rat produced signif-ant whole-blood cholinesterase depression on the tenth ay at a dosage level of 75 r. The levels tested when plotted nd extrapolated indicated threshold changes in cholin-sterase activity would be in the vicinity of 20 to 30 r. AET lone, while producing some mild cholinesterase depression, ailed to protect whole-blood cholinesterase activity from he effects of gamma irradiation at the levels of agent and rradiation tested. (auth)

15450 EFFECT OF SOURCE OF DIETARY CARBOHYDRATE ON SURVIVAL TIME OF SUBLETHALLY X-IRRADIATED MICE. Benjamin H. Ershoff (Western Biological Labs., Culver City, Calif.). Proc. Soc. Exptl. Biol. Med., 106: 605-7(Mar. 1961).

Experiments were conducted to determine the effects of source of dietary carbohydrate on survival time of mice exposed to multiple sublethal doses of total body x irradiation. Findings indicate that average survival time of x-irradiated mice was significantly longer on a glucose-containing diet than on rations containing sucrose, dextrin, or cornstarch as the source of dietary carbohydrate. (auth)

15451 MUTATIONS IN ENDOSPERM AND SPOROPHITE OF THE MAISE PRODUCED BY TREATMENTS WITH X RAYS AND DIEPOXYBUTANE OF THE POLLEN. Angelo Bianchi (Universitá, Milan), Giuseppe Mariani, and Policarpo Uberti. Rend. ist. lombardo sci. e lettere, B, 94: 205-17(1960). (CNEN-30). (In Italian)

Results are reported from a study of the effects of pollen treated with diepoxybutane, with and without doses of 1000 to 2000 r of x radiation, on the induction of mutations in the endosperm and sporophyte of maize plants. A possible interaction was shown between the effects of diepoxybutane and x rays on mutation rate. Results are compared with previously published data. (C.H.)

15452 X-RAYS AFFECT THE INCORPORATION OF 5-IODODEOXYURIDINE INTO DEOXYRIBONUCLEIC ACID. David Gitlin (Harvard Medical School, Boston), S. Lewis Commerford, Ezra Amsterdam, and Walter L. Hughes. Science, 133: 1074-5(Apr. 7, 1961).

When labeled with I^{131}, 5-iododesoxyuridine, an analog of thymidine, is useful in estimating the effect of x radiation on desoxyribonucleic acid metabolism. Although this compound is readily incorporated into desoxyribonucleic acid in the absence of ionizing radiation, it is found that whole-body exposure to as little as 10 r will significantly inhibit its incorporation. (auth)

15453 EFFECTS OF APPLIED RADIATION QUALITY ON THE EXTENT OF GROWING BONE INJURIES IN IRRADIATION OF CHICKEN LEGS IN THE TARSO-METATARSAL JOINT. Pierre van Caneghem and Carl Georg Schirren (Universität, Munich). Strahlentherapie, 114: 370-5(Mar. 1961). (In German)

As soon as the penetrating power of x-rays is strong enough to irradiate the zone of the growing cartilage almost homogenously, their growth-inhibiting action within the treated region (HVL from 1.8 mm Al to 4 mm Cu) is independent of the hardness of the radiation. The gamma rays of the radium inhibit the growth to the same degree as the x-rays. (auth)

15454 DOSIMETRIC STUDIES OF ERYTHEMA AND PIGMENTATION WITH LONG WAVELENGTH X RAYS. Gerhard Stutzer (Universität, Kiel). Strahlentherapie, 114: 386-405(Mar. 1961). (In German)

A report is made about observations of the erythema and the pigment after 480 x-ray radiations with tungsten- and copper-anode-soft-ray-tubes. The observed skin reactions show considerable deviations from the opinions in force at the moment about the relationship between the biological reaction and the physical radiation data. In the analysis of individual radiation reactions and in those summarized in comparable groups, the influence of the spectral composition of different radiations on the biological reaction is emphasized. The elementary importance of the knowledge of the absorption quota of a beam in the different tissue strata is elucidated, and from here an interpretation of the observed reaction phenomena was attempted. (auth)

15455 STUDIES OF THE EFFECTS OF IONIZING RADIATION ON CELL MEMBRANES. I. CHANGES OF IRRITATION INITIATION. Hans-Dietrich Bergeder (Universität, Bonn). Strahlentherapie, 114: 406-14(Mar. 1961). (In German)

After high-dosage x-ray radiation, changes take place in the irritation state of different types of excitable organs (heart, muscles, nerves, the receptors of the skin of frogs, with paramaecia and mice). These changes can, in the beginning, consist of a rising of the excitability, which are found by automatic stimulation processes. Ionizing rays raise the depolarizing power of membranes, especially in membranes with an inclination to spontaneous depolarization. Findings which appear to show a direct stimulation release through ionizing rays, will be valued likewise as an expression of radiation-conditioned depression of the stimulation intensity as opposed to an endogenous stimulation formation. (auth)

15456 STUDIES WITH IONIZATION CHAMBERS FOR DETERMINATION OF ISODOSES OF PENDULUM IRRADIATION WITH ULTRAHARD X RAYS FROM A 15-MEV ELECTRON ACCELERATOR-BETATRON. REPORT V. STUDIES ON THE "PROSTRATE" PHANTOM FOR APPLICATION OF ASYMMETRIC PENDULUM ANGLES. Franz Heinzler and Harald L. Mohr (Medizinische Akademie, Duesseldorf). Strahlentherapie, 114: 472-8 (Mar. 1961). (In German)

On the example of the pendulum angle $-30/+90°$, opinion is given on the body-like water phantom in the question of the usage of asymmetrical pendulum angle position, where measurements with an ionization chamber were carried out. The results were compared with those of the symmetrical pendulum angle. A method for determining the pendulum axis position from the maximum dose and a procedure for the attainment of the dose of the tumor are given. (auth)

15457 THE EFFECT OF β RADIATION ON PHOTOSYNTHETIC-PHOSPHORYLATION AND THE HILL REACTION OF ISOLATED CHLOROPLASTS. W. Füchtbauer and W. Simonis (Universität, Würzburg, Ger.). Z. Naturforsch., 16b: 39-43(Jan. 1961). (In German)

Isolated spinach chloroplasts were exposed to ionizing radiation (β rays) from Sr^{90}. After irradiation the photosynthetic phosphorylation (PP) and Hill reaction (HR) were checked and found to have high but markedly different resistance. Dose effect curves were found indicating fifty percent inactivation of 130,000 rad (PP) or 530,000 rad (HR), respectively. There was no special effect of temperature on radiation resistance of the susceptible photosynthetic phosphorylation. Results are discussed regarding their bearing upon the theory of radiation effects and upon the primary processes of photosynthesis. (auth)

15458 THE EFFECT OF IONIZING RADIATION ON CHLOROPLAST AND HILL REACTION. E. Perner, S. von Falck, and G. Jacobi (Tierärztliche Hochschule, Hanover). Z. Naturforsch., 16b: 74-5(Jan. 1961). (In German)

In order to become acquainted with the behavior of plasmatic structures and their functions under the effects of ionizing radiations, "particle fractions" of isolated chloroplasts of Spinacea oleracea were irradiated with γ radiation with estimation of the Hill reaction. The particle fraction consists of the lamellar components of the chloroplasts, the carrier of photosynthesis. When the fraction showed no measurable change in the Hill reaction, the irradiation time was increased to 5 hr. Even after 5 hr and a dose of 80,000 rad no inhibition of the O_2 evolution was detected. Fractions were then treated with digitonin, and no alteration was noted in the Hill reaction. However, irradiation of the digitonin-treated fraction resulted in a measurable and reproducible inhibition of the Hill reaction. (J.S.R.)

15459 PROTECTION AGAINST IONIZING RADIATION. I. THIAZOLIDINE DERIVATIVES. Randolph Riemschneider (Universität, Berlin-Dahlem, Ger.). Z. Naturforsch., 16b: 75-6(Jan. 1961). (In German)

The protective effect of thiazolidine-4-carboxylic acid was tested on 300-g Wistar rats. The animals received 1000 r whole-body radiation. The acid was injected intraperitoneally or orally 13 to 17 or 28 to 32 min before irradiation. The application 17 min before the irradiation gave a significant protective effect. Of 28 derivatives of thiazolidine only the intraperitoneal injections of the carboxylic acid derivative had any effect. (J.S.R.)

Radiation Sickness

15460 (A/AC.82/G/L.410) ZASHCHITNYI EFFEKT TSISTEAMINA (β-MERKAPTOETILAMINA) NA KHROMOSOMNYE PERESTROIKI V TKANYAKH OBEZ'YAN I MYSHEI. (The Protective Effect of Cysteamine (β-Mercaptoethylamine) on Chromosome Rearrangements in the Tissues of Monkeys and Mice). N. P. Dubinin, M. A. Arsen'eva, and E. S. Kalyaeva (Akademiya Nauk S.S.S.R.). 1960. 14p.

Data are presented on the protective effects of cysteamine against radioinduced chromosome disturbances in gonad germ cells and in bone marrow cells. The data were taken from studies on Macaca mulatta monkeys. Intraperitoneal injections of 3 mg cysteamine, considered to be 150 mg/kg for mice and 100 mg/kg for monkeys, indicated mean protective effects on cells of genetic material epithelium and on bone marrow as 42.75 and 50.77% for mice and 52.4 and 50.8% for monkeys. Cytological studies confirm the higher radiosensitivity of genetic material epithelium cells in monkeys as compared to mice. It is postulated that cysteamine chromosome protection is due to a complex formation of cysteamine molecules with desoxyribonucleic acids. (R.V.J.)

15461 (AD-246422) HISTOPATHOLOGIC EVALUATION OF EFFECT OF DIET ON RESISTANCE TO RADIATION DAMAGE AND TO DEVELOPMENT OF ATHEROMATOUS LESIONS. Report No. 4(Final), November 1, 1958–October 31, 1959. Paul B. Szanto (Hektoen Inst. for Medical Research, Chicago). Contract DA19-129-qm-1334. 96p.

Results are reported from the histologic examination of morphologic findings on samples of tissues from guinea pigs maintained on two different diets and from guinea pigs maintained on similar diets before exposure to single large doses of whole-body radiation. Samples of tissue were examined from gastrointestinal tract, adrenal glands, liver, spleen, bone marrow, lymph nodes, and testes. The histological findings were evaluated without information as to the diets. Results are reported by organ and tissue section for 123 guinea pigs. The development of atheromatous lesions, focal hemorrhage in the bone marrow of unirradiated animals on one diet, and extensive damage of the elastic tissue in both diet groups were the principal findings. (auth)

15462 (NP-9950) PHARMACOLOGICAL STUDIES ON IRRADIATED ANIMALS. VIII. SOME PAPER CHROMATOGRAPHIC ANALYSES OF CELL-FREE SPLEEN EXTRACTS PROTECTING AGAINST RADIATION DEATH. Research Report No. 3. N. Henderson and F. Ellinger (Naval Medical Research Inst., Bethesda, Md.). Jan. 27, 1960. 16p. (DASA-516 Pt.8)

Paper chromatographic studies on cell-free saline extracts from the spleens of mice, guinea pigs, rabbits, and dogs were performed as a first step in the chemical isolation and identification of a common principle or principles of these spleen extracts which might explain their protective action against radiation induced death. These studies were performed on lyophilized and fresh extracts, the water-soluble and -insoluble fractions of dialyzed extracts and the diffusate after dialysis. Pertinent findings concerning identification of 18 amino acids and 5 carbohydrate are reported. The variations observed in the chemical composition of these various spleen extracts offer valuable leads for further studies. (auth)

15463 (QMFCIAF-29-60) ABSENCE OF RADIOPROTECTION IN CABBAGE-FED SWINE. Interim Report. A. H. Munson and Doris Howes Calloway (Quartermaster Food and Container Inst. for the Armed Forces, Chicago). Aug. 1960. 18p. (AD-243757)

Swine were exposed to 11 different dose levels of Co^{60} gamma radiation. Exposures ranged from 75 to 1650 r measured in air. All animals exposed to over 525 r were divided into 2 dietary groups. Basal diet was supplemented with dehydrated cabbage in one group and dehydrated white potatoes in the other. At 75 r per minute, $LD_{100/30}$ was found to be in the range 600 to 676 r. No difference in responses attributable to sex or diet was noted. Clinical behavior and pathologic findings parallel those reported by other investigators. (auth)

15464 (JPRS-7863) EFFECT OF THE TRANSPLANTATION OF BONE MARROW SUSPENSION ON THE COURSE OF ACUTE RADIATION SICKNESS. G. E. (Ye.) Kevlishvili. Translated from Patol. Fiziol. i Eksptl'. Terap., 4: No. 6, 24-7(Nov.-Dec. 1960). 9p.

Intravenous suspensions of homologous bone marrow had a beneficial effect on acute radiation sickness induced in dogs by exposure to 600 r x radiation. Homotransplantation of the bone marrow of puppies was more effective than the bone marrow transplantation of adult dogs, owing to the weaker immunological activity of the tissues of the young animals. The best therapeutic effect was observed in intraosseous transplantation of bone marrow suspensions in puppies. Best results were obtained when the transplantation was carried out on the 3rd or 4th day after irradiation. Multiple transplantations were found to inhibit hemopoiesis and result in death. (C.H.)

15465 (JPRS-7886(p.21-5)) EXPERIENCE IN THE PREDNISOLONE TREATMENT OF ALLERGIC COMPLICATIONS OF X- AND CURIETHERAPY. G. I. Dorofeev (Dorofeyev). Translated from Med. Radiol., 5: No. 10, 18-21(1960).

Several cases of allergic reactions were observed in patients irradiated at 24.1 r/min., 10 × 15 cm fields, 3,000 to 4,000 r in the iliac and sacral region, to a grand total dose

f 15 to 17 kr. Some patients received 45 to 67.5 kr at 6 to 0 kr per session from Co^{60} or Ra–MsTh. Two case histo- ies where prednisolone was prescribed are given. The rednisolone treatment was followed by a rapid reduction n body temperature, reduction in size of exudative phenom- na of the skin, marked reduction of the eosinophil count in eripheral blood, and improvement in the general condition. T.R.H.)

15466 (JPRS-7886(p.26-31)) CHANGES IN THE FUNC- TIONAL CONDITION OF THE HYPOPHYSIS UNDER THE INFLUENCE OF IONIZING RADIATION. A. V. Lebedinskii (Lebedinskiy) and V. V. Yakovlev. Translated from Med. Radiol., 5: No. 10, 21-5(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 5914.

15467 (JPRS-7886(p.36-45)) THE PROTECTIVE EF- FECT OF LOCAL ASPHYXIA OF THE BONE MARROW IN ACUTE RADIATION SICKNESS IN ANIMALS. P. G. Zhereb- chenko, I. G. Krasnykh, N. P. Lebkova, and S. P. Yarmo- nenko. Translated from Med. Radiol., 5: No. 10, 28-35 (1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 5916.

15468 (JPRS-7886(p.57-63)) THE EXCRETION OF DISCHE-POSITIVE SUBSTANCES IN THE URINE IN ANI- MALS OF DIFFERENT SPECIES AFTER INJURY BY ION- IZING RADIATION. T. A. Fedorova, M. S. Uspenskaya, S. S. Vasileiskii (Vasileyskiy), and E. (Ye.) M. Belyaeva (Belyayeva). Translated from Med. Radiol., 5: No. 10, 42-7 (1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 5917.

15469 (JPRS-7886(p.64-9)) SOME LINES OF SEARCH FOR PROTECTIVE COMPOUNDS BY MEANS OF MODEL EXPERIMENTS. G. E. (Ye.) Fradkin. Translated from Med. Radiol., 5: No. 10, 47-51(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 5918.

15470 (JPRS-7886(p.70-6)) THE MECHANISM OF IN- JURY TO THE FETUS IN RADIATION SICKNESS OF A GRAVID ANIMAL. N. A. Kalinina. Translated from Med. Radiol., 5: No. 10, 52-6(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 5919.

15471 (JPRS-7886(p.114-15)) THE ACTIVITY OF THE MAMMARY GLAND OF GOATS UNDER CONDITIONS OF RADIATION SICKNESS. V. N. Borsuk and K. A. Lebedeva. Translated from Med. Radiol., 5: No. 10, 79-80(1960).

An attempt was made to elucidate the change in secretory and motor functions of the mammary glands of lactating goats with radiation sickness. The animals received 300 or 500 r whole-body radiation in the second-third month of lactation. The mammaries were shielded. The quantity of milk decreased or lactation stopped. The fat and casein content decreased; the P increased markedly. The latent period of the second phase of the lactation reflex increased. No histologic changes in the mammary glands were found. (T.R.H.)

15472 (JPRS-7886(p.116-17)) THE DEVELOPMENT OF EDEMA IN A FOCUS OF THERMAL INJURY IN IRRA- DIATED RABBITS. M. V. Svyatukhin, V. M. Chernykh, and D. N. V'yunskovskii (V'yunskovskiy). Translated from Med. Radiol., 5: No. 10, 80(1960).

An experimental study is briefly described in which it was found that in rabbits exposed to a single gamma irradiation over the entire body with a dose of 600 to 700 r, the edema of the burned tissues increases more slowly and remains at a lower level than in the controls. One of the essential causes of this is spasm of the skin blood vessels after irradiation. The tendency toward necrosis of burned tissues increases. (T.R.H.)

15473 (JPRS-7902) TRANSLATION OF ARTICLES ON RADIATION SICKNESS FROM THE GREAT MEDICAL ENCYCLOPEDIA. Translated from Bol'shaya Meditsin- skaya Entsiklopediya, 16: No. 2, Moscow, 1960. 87p.

The pathogenesis of radiation sickness is reviewed. Clinical aspects, diagnosis, treatment, complications from infections, immune reactions, and the late consequences of radiation sickness are discussed in detail. The characteristics and handling of radiation sickness under field conditions are considered. A brief discussion is included on skin cancers and other radiation injuries in radiologists and others working with x rays. (C.H.)

15474 PROTECTIVE EFFECT OF HYPOXIA AT VARI- OUS RADIATION DOSES. I. B. Bychkovskaia and G. K. Ochinskaia (Central Research Inst. of Medical Radiology, Ministry of Health, Leningrad). Biophysics (U.S.S.R.)(Eng- lish Translation), 5: No. 4, 532-8(1960).

The doses of Co^{60} γ rays used in studies of the dose-effect relationship were 1000, 1100, 1200, and up to 2100 r. The survival rate of mice may be broken down into several groups within which change in the size of dose did not lead to change in the survival rate. The protective effect of hypoxia was only noted on irradiation with doses occupying the initial places in the groups. For the third and fourth doses of the groups the survival rate of the animals irradiated in conditions of hypoxia did not differ from that for the control mice irradiated normally. The relation between the protective effect of hypoxia and the radiation doses make it possible to embark on a quantitative assessment of the protective effect. (auth)

15475 THERAPEUTIC ACTION OF GALLIC ACID DERIVATIVES IN ACUTE RADIATION SICKNESS. A. A. Gorodetskii, V. A. Baraboi, and V. P. Chernetskii (Bogo- molets Inst. of Physiology and Inst. of Organic Chemistry, Academy of Sciences, Ukrainian, S.S.R.). Dopovidi Akad. Nauk Ukr. R.S.R., No. 12, 1635-7(1960). (In Ukrainian)

Sodium gallate and propyl gallate produced survival of up to 50% of mice irradiated with a minimum lethal dose (600 r). The preparations are effective in preventive administration and in large doses immediately after irradiation. The application of gallates at a longer interval after irradiation (one hour later) is considerably less effective. (tr-auth)

15476 THE EFFECTS OF EXOGENOUS AND ENDOG- ENOUS FACTORS ON THE RADIATION REACTION OF THE HEAD. REPORT 2. THE EFFECTS OF LOCAL AGENTS ON THE COURSE OF X-RAY ERYTHEMA IN EXPERIMENTAL ANIMALS. Karl Heinz Kärcher (Uni- versität, Heidelberg, Ger.). Strahlentherapie, 114: 376- 85(Mar. 1961). (In German)

Experimental examinations of rabbit ears using various salve bases of powder and a fatfree gel-like cream incorporating antiphlogistic acting substances such as azulen and hydrocortisone confirmed the supposition, that the applied salve base is of decisive importance to the course of the x-ray reaction of the skin. The acting substances are most effective in a fatfree gel-like salve. A 1% hydrocortisone gel-salve gave the strongest antiphlogistic effect. A thermal treatment carried out during radiation produced and increase of reaction, as could be shown for microwaves. (auth)

CHEMISTRY

General and Miscellaneous

15477 (AERE-R-3451) X-RAY DIFFRACTION IN PHASE STUDIES. Papers Presented at the Fourth Colloquium of the U.K.A.E.A. Diffraction Analysis Conference held at A.E.R.E. Harwell on the 5th April 1960. L. E. J. Roberts, ed. (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Aug. 1960. 18p.

Information from an oral presentation on the role of diffraction studies in physical chemistry is given. The emphasis is on phase studies and is presented from an academic viewpoint. Questions considered include the type of chemical bonding in a particular structure, factors affecting stability, and the mechanisms by which one structure is transformed into another. Information is also given on the role of x-ray-diffraction in metallurgical investigations. (J.R.D.)

15478 (ARL-8) INTERNAL CONVERSION PROCESSES IN BIACETYL. Jean T. Dubois (Wright Air Development Center. Aeronautical Research Lab., Wright-Patterson AFB, Ohio). Jan. 1961. 4p.

It is shown that for biacetyl molecules in the gas phase, the rate of interstate crossing $I'A_u \rightarrow T$ is independent of the vibrational energy content of $I'A_u$ state. On the other hand, the rate of internal conversion $T \rightarrow {}'A_g$ obeys the equation: $i = 6.5 \times 10^{7} \exp(-7500/RT)$. (auth)

15479 (CEA-1787) EXEMPLES D'EMPLOI DE LA CHROMATOGRAPHIE GAZEUSE PREPARATIVE DANS LA FABRICATION DES MOLECULES MARQUEES. (Examples of the Use of Preparative Gas-Phase Chromatography for Producing Labelled Molecules). Louis Pichat, Christian Baret, Jean-Pierre Guermont, and Marcel Audinot (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1960. 16p.

Gas chromatography is most widely used in the analysis of volatile products. Certain works mention its use for preparatory purposes. Organic-labeled molecule preparations are usually made in quantities of the order of 1 to 10 mmole. It has thus been possible to use gas chromatography with very little alteration for the purification of C^{14} labeled molecules and their separation from complex reaction mixtures. The apparatus employed is described briefly. (auth)

15480 (GAMD-2079) RECENT PROGRESS IN HTGR INTERNAL FISSION PRODUCT TRAPPING STUDIES. R. M. Watkins (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Feb. 24, 1961. Contract AT(04-3)-314. 21p.

A study was made of the high-temperature fission product trapping capabilities of various charcoals and metal-charcoal combinations in an attempt to develop a satisfactory trap for use in gas-cooled reactors. Tests of the iodine and tellurium trapping capabilities of silver and copper coated charcoal at temperatures up to 900°F were conducted. It was observed that metal coated charcoal exhibits much better holdup characteristics compared to metal mesh or turnings alone. The capacity for delaying radioiodine was measured in terms of "Reactor Equivalent Delay" (in days) to give an indication of how long a particular iodine atom entering one of the traps could be expected to remain. It was found that coconut charcoals exhibited greater delay characteristics than charcoals of coke origin. A strong dependence of delay time on temperature was observed. Silver coatings caused a longer delay than copper. (M.C.G.)

15481 (IA-597) STRUCTURAL REQUIREMENTS OF ORGANIC LIQUID SCINTILLATORS. Adam Heller (Israel. Atomic Energy Commission, Tel-Aviv). Jan. 1961. 13p.

A theory is proposed to explain the relationship between the structure and the scintillation efficiency of organic liquid scintillators. The requirements for good scintillation properties in given solvent-solute systems include the existence of pairs of energy levels in the solute which are identical with those involved in the excitation of the solvent, and a non-rigid structure in the solute capable of undergoing conformational changes in the excited state. It was found that the behavior of liquid scintillators satisfied these requirements. A hitherto unknown scintillator, 9-vinylanthracene, for which good scintillation properties were predicted, was indeed found to be a high-grade primary or secondary scintillator, capable of replacing the expensive POPOP. (auth)

15482 (IS-215) KINETICS OF THE ALKYLATION AND ACYLATION OF NICKEL DIPIVALOYLMETHIDE. K. E. Johnson and G. S. Hammond (Ames Lab., Ames, Iowa). July 1959. Contract W-7405-eng-82. 64p.

A study was made of the reactions of nickel dipivaloylmethide with the following reagents: triphenylmethyl chloride, benzoyl chloride, and p-chloro and p-methyl benzoyl chloride. Infrared spectra of the easily hydrolyzed product of tritylation seemed to indicate that the enol ether, the product of O-alkylation, is formed. The acyl halides reacted to give the triketones. The latter were characterized by spectra and C, H, analysis. The kinetics of all the reactions studied were found to settle down to a second order rate law after a fast initial reaction. The rate law is illustrated by the equation: rate = k_2 [Ni(DPM)$_2$] [R-Cl]. The tritylation did not take place at 50° when the reaction flask was flushed with nitrogen. These reactions were catalyzed by aluminum chloride and nickel pivalate. The acylations were catalyzed by an impurity in the acyl chloride. When benzoyl chloride with different purity was used, the second order rate constant for the benzoylation of nickel DPM ranged from 0.02 to 0.20. The rate of p-methoxybenzoylation was the same as that for benzoylation. The p-chlorobenzoylations studied were about twice as fast. The fast rate of the latter was attributed to the presence of a higher percentage of catalyst, which is probably the acid. The air oxidation of nickel dipivaloylmethide was found to compete with the acylations under the conditions of these studies. An investigation of this phenomenon showed that nickel pivalate is the major product. Pivalic acid was also detected in the product mixture. This oxidation took place in chlorobenzene and in aromatic hydrocarbons. It occurred in cyclohexane when small amounts of benzoyl chlorides were present. (auth)

483 (NP-9969) HIGH TEMPERATURE CRYSTAL EMISTRY. Status Report No. 1. October 1, 1960—Decem- r 31, 1960. I. P. Mayer, A. Goldstein, A. Batt, B. Post, d E. Banks (Brooklyn. Polytechnic Inst.). Contract AF49 8)-827. 6p.

The digermanides of the rare earth metals are prepared order to investigate their composition, properties, and ucture. The reactions between germanium and the rare rths were carried out in alumina crucibles by heating in induction unit. The x-ray patterns of the samples were termined. A system for complete analysis of metal oxides d the alkali tungsten bronzes is being completed. The ethod involves the reaction of BrF_3 with the formation of e metal fluorides and pure oxygen. An investigation was dertaken to determine, with precision, the parameters of e oxygen atoms in yttrium iron garnet. (M.C.G.)

5484 (NYO-2301) REPORT OF PROGRESS [ON HEMISTRY RESEARCH] AND EXPENDITURES, MAY 1, 960—MAY 1, 1961, AND PROPOSALS FOR THE COMING EAR. (Massachusetts Inst. of Tech., Cambridge. Lab. r Nuclear Science). Contract AT(30-1)-905. 183p.

Investigations were continued on the analytical chemistry a number of elements, the development of new analytical ethods and techniques, and fundamental studies of elec- rode processes, luminescence, and physical-chemical eparations. A discussion is given of physico-chemical tudies on the properties of electrolyte solutions, ion xchange and related processes in carrying, solvent ex- caction processes, and the use of divalent silver as an xidizing agent. Work done on studies of analytical and nstrumentation techniques, general nuclear chemistry roblems, and fission radiochemistry is described. Dis- ussions are given of work conducted on substitution mech- nisms of triphenyl-methyl halides in benzene, Cannizzaro eaction mechanisms, solvent isotope effects in nucleophilic isplacement reactions, relative reactivities of nucleophilic eagents in methanol and benzene, structural effects on eaving group isotope effects in ionization reactions, mech- nisms of displacements on silicon, catalytic exchange on nethyl hydrogens in methyl and neopentyl alcohols, conver- ion of ammonium cyanate to urea, oxygen rearrangement n triphenylmethyl benzoate, hydrogen exchange between lcoholic oxygens, and electrophilic reactions of peroxygen compounds. (B.O.G.)

15485 (NYO-7579) FUSED SODIUM HYDROXIDE. Progress Report, June 1, 1957—June 1, 1958. Ralph P. Seward (Pennsylvania State Univ., University Park). June 1958. Contract AT(30-1)-1881. 9p.

Measurements of the rate of decomposition of perchlorate on at 330 to 400°C in fused sodium hydroxide are reported. The decomposition is found to be first order with an activa- ion energy of 60 k cal per mole. The rate is not altered by ddition of KCl, Na_2CO_3, Al, or Al_2O_3; MgO retards the re- action. The disproportionation of iodate to iodide and perio- date in fused NaOH is reported. Iodide is oxidized to perio- date in fused NaOH by atomsphere oxygen. Silver chloride is decomposed to silver in fused NaOH and silver iodide partly decomposed. In the KOH—NaOH system a eutectic is found at 170°C and 40 wt. % NaOH. Solid solubility is very slight. (auth)

15486 (NYO-8525) INORGANIC ELECTROLYTES IN ANHYDROUS ACETONITRILE. Technical Report No. 5. George J. Janz and Arthur E. Marcinkowsky (Rensselaer Polytechnic Inst., Troy, N. Y.). Jan. 1961. Contract AT (30-1)-1999. 190p.

Research concerned with the properties of inorganic electrolytes in anhydrous acetonitrile is reported. Information related to ionic interactions, solute-solvent interactions and solute-solute interactions is emphasized. The work is differentiated into phases including that pertaining to the region of dilute concentration in which KI was studied, the region of high concentration in which $AgNO_3$ was studied, and systems which exhibit pronounced complex-ion behavior for which the cobaltous halide salts were investigated. Discussions of procedures, and result interpretation are included with data. (J.R.D.)

15487 (NYO-9565) THERMODYNAMIC, SPECTRAL AND STRUCTURAL STUDIES OF COMPLEX IONS. Annual Report for September 15, 1960—September 14, 1961. (Massachusetts Inst. of Tech., Cambridge). Mar. 15, 1961. Contract AT(30-1)-1965. 10p.

Activities in the area of transition element coordination chemistry are reported. A summary is given of work in β-diketone complexes of Ni(III), planar high-spin complexes of Co(II), tetrahedral Ni(II) complexes, phosphine and arsine oxide complexes, Co(II) complexes and on the sulfoxides and their complexes. (J.R.D.)

15488 (TID-11167) CHELATES OF 4-HYDROXY-BENZOTHIAZOLE AND ITS ANALOGUES. PROGRESS REPORT OCTOBER 1, 1959 THROUGH OCTOBER 31, 1960. Quintus Fernando (Pittsburgh Univ. Department of Chemistry). November 1960. 16p. Contract AT(30-1)-2332.

An investigation is presented of the chelating tendencies of 4-hydroxybenzothiazole toward the rare earths. Preparation and determination of the metal chelates are reported. (W.L.H.)

15489 (TID-12313) PHASE EQUILIBRIA STUDIES OF SYSTEMS INVOLVING THE ALKALI AND ALKALINE EARTH METALS. Report No. V. Frank A. Kanda and Alden J. King (Syracuse Univ., N. Y. Research Inst.). Mar. 1961. Contract AT(30-1)-1910. 30p. (Chem-1620.411P-6003R4).

Equipment and techniques were developed to produce metals of the highest possible degree of purity. The furnace unit was designed on a scale to allow for the production of at least 2 kg. of metal per run. New methods were developed to destroy the porous nature of the pure metal condensate before exposure to air. This gave a more highly purified product. Establishment of the phase boundaries in the Ba-Na system was completed. Contrary to conclusions drawn from preliminary studies of this system, there appeared to be only one compound. Thermal analysis indicated the compound composition to fall between 30 and 33.3 at.% Ba. Phase studies were also completed on the Ca-Mg system. Non-equilibrium phenomena in the system as well as phase transitions in "pure" calcium from various sources were investigated. In the thermal analysis of the Sr-Na system, it was impossible to obtain liquidus points in the sodium-rich alloys. The liquidus in the Ca-Li system was completely established. An isothermal boundary at 373°C was found for alloys over the range from 77 to 95 at.% Ca. Factors influencing the character of the metallic bond and the nature of alloy phases were investigated. The possible systems between alkali and alkaline earth metals are listed. The crystal structure of Sr_3Li_2 was refined by means of least squares using the "Mifri" program and an IBM-704 computer. (M.C.G.)

15490 (TID-12353) A STUDY OF THE KINETICS OF METAL DISSOLUTION IN AQUEOUS ACIDS. Progress Report and Proposal for Renewal and Extension of Contract. H. E. Hoelscher and Chatten Cowherd (Johns Hopkins Univ., Baltimore). Mar. 1961. Contract AT(30-1)-2334. 17p.

Three mathematical analyses of systems which externally may be diffusionally controlled are discussed. These

analyses were used to treat the data obtained in a study of the kinetics of fast chemical reactions at interfaces. Design and construction of apparatus were completed. The reaction selected for study was the solution of solid iodine in KI. Data were obtained in the form of a plot of mean exit concentrations as a function of contact time. The resulting rate constant appeared to be independent of both the position of the tube and of the concentration. Results of the analyses indicated that it is possible to obtain kinetic information from a reaction system in which diffusion is obviously the controlling or limiting factor. (M.C.G.)

15491 (TID-12366) THE COPRECIPITATION OF METALLIC IONS WITH CALCIUM CARBONATE. Progress Report. Heinrich D. Holland, U. M. Oxburgh, T. V. Kirsipu, M. Borcsik, and A. Mookherjee (Princeton Univ., N. J.). June 1, 1960. Contract AT(30-1)-2266. 14p.

Water, carbonate deposits, and country rock from the Luray Caverns, Luray, Virginia were analyzed for Ca, Mg, and Sr. The distribution factor of Sr between solid $CaCO_3$ and solutions was determined in order to compare the results with those obtained in laboratory precipitation experiments. The variability of the Mg and Ca concentrations in the cave waters was assumed to be related to the solution and deposition of carbonates. The Sr/Ca distribution factors were in reasonable agreement with those found in the laboratory indicating that laboratory values can be applied to geological situations in which precipitation takes place very slowly. The Ca, Mg, and Sr content of some sea water samples was determined. The Ca/Mg and Sr/Ca ratios obtained were in excellent agreement with literature values. In the precipitation of calcite at 200°C, it was found that the addition of a small volume of concentrated urea solution under pressure to a bomb containing a slightly acid $CaCl_2$ solution yields acceptable results where other techniques failed. The incorporation of Cd^{2+} in β-ZnS was studied at 60 and 90°C. When precipitation was carried out in solutions of $Zn(NO_3)_2$ acidified with HNO_3 using thioacetamide to supply the S^{2-} ions, CdS was apparently always precipitated before ZnS. However, when NaCl was added to the solutions, no precipitate was observed. The difference in the results was due to preferential complexing of the Cd^{2+}. (M.C.G.)

15492 (TID-12389) COMPLEXES OF COPPER(II) AND SOME 5-SUBSTITUTED TETRAZOLES. Ned A. Daugherty and C. H. Brubaker, Jr. (Michigan State Univ., East Lansing. Kedzie Chemical Lab.). [1960]. 14p.

The complexes of Cu(II) and 5-phenyltetrazole and some substituted 5-phenyltetrazoles were studied. Bis(5-phenyltetrazolato)copper(II), $Cu(C_7H_5N_4)_2 \cdot H_2O$, was characterized. Monotetrazole complexes $Cu(C_7H_5N_4)OH$ and $Cu(C_7H_5N_4)Cl$ were also prepared. Visible and ultraviolet spectra of $Cu^{++} + C_7H_6N_4$ in methanol were studied as were the infrared spectra of the solids. The 5-phenyltetrazolate ion seemed to satisfy two coordination positions on copper. 5-o-chloro- and 5-m-chlorophenyltetrazole and 5-o-tolyltetrazole gave solids of the form CuT_2 (T = tetrazole) but 5-p-nitro and 5-p-chlorophenyltetrazole formed compounds of the type $Cu_2T_2SO_4 \cdot 2H_2O$. With 5-p-methoxyphenyltetrazole and 5-p-tolyltetrazole solids formed which did not correspond to any simple formula and were probably not pure. Studies of the effects of aqueous anions on the rapidity of formation and structure of precipitates of bis(5-aminotetrazolato)copper(II) were made. It was found that Cl^-, SO_4^{2-} and NO_2^- cause the $Cu(CN_5H_2)_2$ to form rapidly as the light green phase, while the dark green (blue) phase separated only very slowly when the anions were ClO_4^-, NO_3^-, PO_4^{3-}, $C_2H_3O_2^-$, Br^-, HCO_3^-. With Cl^- and SO_4^{2-} the amounts of solid depended on the concentrations of the anions, but the $Cu(CN_5H_2)_2$ contained only traces of Cl^- or SO_4^-. The effect is probably due to nucleation of the light green solid by a trace of some solid chloro- or sulfato-complex. (auth)

15493 (TID-12391) ELECTROLYSIS WITH CONSTANT POTENTIAL: EFFECT OF DIFFUSION COEFFICIENTS ON REVERSIBLE REACTIONS AT A SPHERICAL ELECTRODE. Irving Shain and Daniel S. Polcyn (Wisconsin. Univ., Madison). 1961. Contract AT(11-1)-64. 8p.

The use of stationary spherical electrodes in electrolysis experiments at constant potential is discussed. The equation for the current-time curve was derived for the case of a reversible reaction taking place at potentials near E^0. The effects of diffusion coefficients were investigated. Current-time curves for the reduction of titanium(IV) oxalate complex were analyzed. It was found that the diffusion coefficient of the Ti(III) complex is less than that of the Ti(IV) complex. (M.C.G.)

15494 (TID-12487) THE REACTION BETWEEN U(IV) AND H_2O_2. F. B. Baker and T. W. Newton (Los Alamos Scientific Lab., N. Mex.). 1961. 12p.

Experiments were carried out to determine the nature of the reaction between U(IV) and H_2O_2 in aqueous $HClO_4$ solutions. The net reaction was expected to be $U^{4+} + H_2O_2 \rightarrow UO_2^{2+} + 2H^+$, but results indicated that it is, in part at least, a chain reaction and that it is accompanied by a small amount of H_2O_2 decomposition. The average second-order rate constant was found to be 56.8 ± 1.85. Oxygen was found to have a significant effect on the kinetics of the U(IV)-H_2O_2 reaction. Four additional runs were made in which the solutions were deaerated with argon; these gave average second order rate constants ranging between 38 and 44 M^{-1} min^{-1}. The catalytic effects of Hg, Pb, Ag, Mn, Fe, Cu, and Co ions were investigated. (M.C.G.)

15495 (TID-12492) TRACTABLE POTENTIAL FUNCTIONS AS DERIVED FROM THEORIES OF BONDING FOR METAL CARBONYLS AND METAL CYANIDE COMPLEXES. Llewellyn H. Jones (Los Alamos Scientific Lab., N. Mex.). [1960?]. 30p.

Various potential functions used for normal coordinate analyses of molecular vibrations are discussed. In a general quadratic potential function there are too many force constants to determine from the observed frequencies. Therefore, a pi-electron interaction valence force field is derived for the octahedral metal hexacarbonyls. The results of application of this treatment to $Mo(CO)_6$ are given and shown to be quite satisfactory. The Urey-Bradley Field, which gives satisfactory results for some molecules is shown to be inferior for metal carbonyls. A brief discussion of the modification of this πIVFF for metal-cyanide complexes is presented. (auth)

15496 (TID-12507) BONDING MECHANISMS IN THE TRANSITION METAL HYDRIDES. Richard L. Beck (Denver. Univ. Denver Research Inst.). [1960]. Contract [AT(33-3)-3]. 11p.

The effective hydrogen radii in the transition metal hydrides were calculated on the basis of crystal geometry and verified by calculations based on Pauling's rules for metallic radii. These data showed that the M-H bonds are predominantly metallic, with no more than the predicted 25% ionic character based on electronegativity. Arguments are presented which indicate that uranium does not exhibit its maximum metallic valence in the UH_3 compound. Evidence is also presented using LaH_2 as an example which shows that the metal atoms in the rare earth trihydrides are bonded metallically to the first two hydrogen atoms but are bonded ionically to the third hydrogen. (auth)

497 (TID-12508) THE WIEN EFFECT OF URANYL LT SOLUTIONS (thesis). Joseph F. Spinnler (Yale Univ., w Haven). Sept. 1960. 180p.

An IBM 650 computer program for calculating the theoretl Wien effect (increase in conductance with high fields) the method of Onsager and Kim is outlined. The Wien ect was measured for aqueous solutions of UO_2F_2, UO_2SO_4, $)_2(NO_3)_2$, and $UO_2(ClO_4)_2$ at temperatures ranging from 5 to °C. Data are given together with pH and concentration ta. The results are compared with the theoretical Wien ects and interpreted in terms of ionic equilibria. A nega-e Wien effect, the first one ever observed, was found for $)_2(NO_3)_2$ and $UO_2(ClO_4)_2$ especially at the higher tempera-res. (D.L.C.)

498 (AEC-tr-4376) TRANSACTIONS OF THE V. G. HLOPIN RADIUM INSTITUTE. Translation of Trudy adievogo Instituta imeni V. G. Khlopina, Volume VII, 1956. . I. Starik, ed. 235p.

Twenty papers from a symposium of the V. G. Khlopin adium Institute are presented. Nineteen of these papers e covered by separate abstracts. One was previously ostracted for Nuclear Science Abstracts. (M.C.G.)

5499 (AEC-tr-4376(p.5-14)) NEW DATA ON THE ENZOYL- AND ACETYLACETONATES OF URANYL. .. A. Grinberg and A. D. Troitskaya. Translated from rudy Radievogo Inst. im. V. G. Khlopina, 7: 5-13(1956).

Results obtained in a study of the compounds of uranyl ons with 1,3-diketones are described. The degree to hich the ability to enter into combination with compounds haracterized by the presence of keto-end tautomerism, nd particularly with analogs of acetylacetone, is specific or the uranyl ion was determined. The reactions of uranyl alts with acetylacetic ester and benzoylacetone were studed. The properties of anhydrous and hydrated uranyl ben-oylacetonate are discussed. Its molecular weight was letermined in $CHBr_3$. The dipole moments of uranyl benzoyl-cetonate and uranyl acetylacetonate were measured in enzene. (M.C.G.)

15500 (AEC-tr-4376(p.15-17)) CONCERNING THE PREPARATION OF URANIUM HEXACARBONYL. A. A. Grinberg, B. V. Ptitsyn, F. M. Filinov, and V. N. Lavrent'ev. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 7: 14-16(1956).

It is shown that the formation of a volatile uranium hexacarbonyl does not occur under the conditions of synthesis of the hexacarbonyls of Cr, Mo, and W by the method of Giber and Romberg. Such a sharp departure from the analogs above it led to the assumption that uranium hexacarbonyl does not exist. From this assumption, a series of observations were made concerning the structure of the seventh period of the periodic table. (M.C.G.)

15501 (AEC-tr-4376(p.18-53)) A STUDY OF THE OXALATE COMPOUNDS OF TETRAVALENT URANIUM. A. A. Grinberg and G. I. Petrzhak. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 7: 17-49(1956).

Uranium oxalates were prepared in an attempt to study their physical-chemical properties in greater detail and to use these data to determine the structure of uranium oxalate. The compound was prepared by precipitation of solutions of tetravalent uranium compounds with oxalic acid, by electrolytic reduction of uranyl oxalate, and by using an oxalic acid solution to precipitate a uranium chloride solution obtained by dissolving metallic uranium in HCl. The K, Ba, Pb, Cd, and Ca salts of uranium oxalate were prepared. It was determined that the solubility of uranium oxalate at a temperature of 18° lies within the approximate range from 3.75×10^{-2} to 4.42×10^{-2} g/l or from 7.18×10^{-5} to 8.46×10^{-5} mole/l. The coordination formula of the potassium salt having the composition $K_4[U(C_2O_4)_4] \cdot 5H_2O$ and the nature of its ionic dissociation were established by electrical conductivity measurements. An analysis of a potentiometric titration curve showed that a process of oxidation of U^{IV} to U^{VI} occurs first, followed by the process of oxidation of the oxalate groups. The magnetic susceptibilities of the oxalate having the composition $U(C_2O_4)_2 \cdot 6H_2O$ and of the K, Ba, and Cd salts of the acid $H_4[U(C_2O_4)_4]$ were studied in the solid state. All of the compounds were found to be paramagnetic. Their magnetic moments were governed by the presence of two unpaired electrons. The absorption spectra of solutions of the salt $K_4[U(C_2O_4)_4] \cdot 5H_2O$ were measured. Comparison of these spectra with other results indicated that the ionic bond predominates in the compounds studied. (M.C.G.)

15502 (AEC-tr-4376(p.54-80)) AN INVESTIGATION OF THE PHYSICAL-CHEMICAL PROPERTIES OF THE OXALATES OF TETRAVALENT URANIUM AND THORIUM. A. A. Grinberg and G. I. Petrzhak. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 7: 50-73(1956).

An investigation was made of the properties of $U(C_2O_4)_2 \cdot 6H_2O$ and certain of its derivatives. The physical and chemical properties of the oxalates of uranium and thorium were compared. The pH and electrical conductivites of the oxalate solutions were measured. The thorium oxalate differed sharply from the tetravalent uranium with respect to both pH and molecular conductance. Uranium oxalate was found to be an acid, while thorium oxalate exhibited virtually no acid properties. The dissociation formulas for the oxalates were determined. The acid properties of uranium oxalate were also confirmed by its reaction with gaseous pyridine. The solubility of uranium oxalate in water at 25° was found to be 5.0×10^{-2} g of the hexahydrated salt per 1000 g of solution. The solubility of thorium oxalate was lower almost by half. It was about 2.3×10^{-2} g of the hexahydrated salt per 1000 g of solution. The solubility of uranium oxalate in 0.1N, 0.5N, and 1N solutions of H_2SO_4, HNO_3, $HClO_4$, and $HC_2H_3O_2$ was determined. It was established that the solubility of uranium oxalate is considerably lower in the 0.1N acids than in water. (M.C.G.)

15503 (AEC-tr-4376(p.81-96)) PHYSICO-CHEMICAL PROPERTIES OF AQUEOUS SOLUTIONS OF COMPLEX URANYL OXALATES. A. A. Grinberg, B. V. Ptitsyn, and E. N. Tekster. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 7: 74-86(1956).

A study was made of the physical and chemical properties of complex uranyl oxalates in aqueous solutions. Complexes with K^+ and NH_4^+ were investigated. Compounds with the compositions $K_2[UO_2(C_2O_4)_2] \cdot 3H_2O$, $K_6[(UO_2)_2(C_2O_4)_5] \cdot 10H_2O$, and $(NH_4)_2[UO_2(C_2O_4)_2] \cdot 2H_2O$ were isolated and analyzed. The conductivity of the oxalate complexes of uranyl remained constant in diffuse light at constant temperature. The conductivity of the uranyl oxalate solutions, however, declined in time under diffuse light due to decomposition of the aqueous solution of this compound by light. The pH values of the solutions were measured using calibrated glass electrodes. Curves of the molar conductivity as a function of the square root of the concentration were constructed on the basis of the conductivity measurements. These pH and conductivity measurements established that in aqueous solution, uranyl oxalate dissociates according to the schemes $UO_2C_2O_4 \rightleftharpoons UO_2^{2+} + C_2O_4^{2-}$ and $[UO_2C_2O_4(H_2O)] \rightleftharpoons H^+ + [UO_2C_2O_4(OH)]^-$. In potentiometric titration with alkali, two potential jumps were observed. One corresponded to the addition of one mole of NaOH to one mole of uranyl

oxalate to form $Na[UO_2C_2O_4(OH)]$. The second jump corresponded to the formation of $UO_2(OH)_2$. Further addition of alkali resulted in the formation of polyuranates. (M.C.G.)

15504 (AEC-tr-4376(p.97-102)) SYNTHESIS OF U_3O_8 FROM THE URANIUM OXIDES UO_2 AND UO_3. Yu. M. Tolmachev. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 7: 87-91(1956).

Synthesis of U_3O_8 was attempted using UO_2 and UO_3. Calculations indicated that if it is possible, the reaction should be exothermic and liberate 15.5 kcal per mole of U_3O_8: $UO_2 + 2UO_3 \rightarrow U_3O_8 + 15.5$ kcal. The oxides UO_3 and UO_2 were placed in separate test tubes and heated in a vacuum to remove adsorbed gases and moisture. Then, still in vacuo, the tubes were joined and the contents mixed by shaking. After mixing, the tube with the mixture was unsealed and placed in a furnace at 340°C. After 7.5 days the mixture acquired the dark green coloration characteristic of U_3O_8. Analysis of the mixture showed it to be 88% U_3O_8. Further experiments showed that the reaction in which the U_3O_8 forms from UO_2 and UO_3 is a pure solid-phase reaction. A value K' was calculated as a "radii-averaged" constant which characterizes the reaction rate. (M.C.G.)

15505 (AEC-tr-4376(p.103-9)) THE ABSORPTION SPECTRA OF AQUEOUS SOLUTIONS OF TETRAVALENT-URANIUM SALTS IN THE VISIBLE REGION. V. N. Ushatskii and Yu. M. Tolmachev. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 7: 92-7(1956).

The absorption spectra of the salts UCl_4, UBr_4, $U(SO_4)_2$, and $(NH_4)_4[U(C_2O_4)_4]$ were investigated in aqueous solutions using a small spectrograph with a diffraction grating which had 6493 lines per cm. and gave a first-order reciprocal line dispersion of about 40A per mm. Ten bands were observed for each of the four salts: 4 in the orange-red region, 2 in the green, and 4 in the blue-violet. The band maxima of the halides and sulfate occurred extremely close together even in concentrated solutions. The small difference in the positions of the maxima were accounted for by the difference between the electrostatic effects of the anions. Only for the uranium oxalate solution was a significant overall displacement of the band maxima observed. The differences between the maxima practically vanished as the solutions were diluted. It was concluded that the carrier of the absorption spectrum is the same for both the solid salts and their solutions and is the ion U^{4+}. (M.C.G.)

15506 (AEC-tr-4376(p.110-14)) PHOTOCHEMICAL OXIDATION REACTION OF TETRAVALENT URANIUM. V. N. Ushatskii and Yu. M. Tolmachev. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 7: 98-102(1956).

A series of experiments to study photochemical oxidation of tetravalent uranium salts in solution established that the rate of oxidation of U^{4+} to UO_2^{2+} by oxygen is higher in simple salts if the solution being oxidized is illuminated by visible light. However, salts of U^{4+} were found to be strongly oxidized even in darkness. The oxidation rate declined significantly in the presence of acids, both in darkness and under illumination. A purely photochemical reaction of the U^{4+} ion was discovered: oxidation of a uranium ammonium oxalate solution by oxygen. A mechanism is proposed for the photochemical oxidation of tetravalent uranium salts in solution. (M.C.G.)

15507 (AEC-tr-4376(p.115-19)) THE REACTION OF THE DOUBLE FLUORIDE OF URANIUM^{IV} AND AMMONIUM WITH SOLUTIONS OF ALKALI CARBONATES. O. V. Andreevskaya, R. V. Venediktova, A. D. Yadrintseva, L. P. Lashkova, and Yu. M. Tolmachev. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 7: 103-6(1956).

It was established that the double fluoride of U^{4+} and NH_4^+ is readily soluble in concentrated solutions of Na_2CO_3, $NaHCO_3$, and $(NH_4)_2CO_3$. The respective solubility values at the maxima were 6.6, 2.4, and 5.0 g per 100 ml of solution. Dilution of the solutions to 10 or more times the initial volume caused complete hydrolysis and deposition of all the uranium in a precipitate. The addition of acid caused the precipitation of all the uranium in a light-green precipitate. An excess of acid caused the precipitate to dissolve completely with the formation of a green solution in which most of the uranium is present in the tetravalent form. The addition of KOH to a solution of the double fluoride in alkali carbonates caused the uranous oxide hydrate to separate immediately. The process of solution of the double fluoride in alkali carbonate solutions was investigated. It was established that a process in which U(IV) is oxidized to U(VI) proceeds concurrently with the solution process. A hypothesis to the effect that the uranium is oxidized by carbonic acid is advanced. (M.C.G.)

15508 (AEC-tr-4376(p.129-41)) THE INFLUENCE OF VARIOUS ELEMENTS ON THE LUMINESCENCE OF URANIUM IN SODIUM FLUORIDE. I. E. Starik, F. E. Starik, L. Ya. Atrashenok, A. Ya. Krylov, G. B. Kostyrev, and V. N. Kosyakov. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 7: 114-25(1956).

An investigation of the influence of the various ions on the luminescence of uranium nitrate was conducted using 5 mg NaF beads containing from 2×10^{-9} to 8×10^{-9} g of uranium. The effects of 45 different elements were studied and classed into 5 groups in accordance with their effect on luminescence. Na, K, Rb, Zn, Ti, S, Mo, W, Ce, Br, and I exerted no significant influence on the luminescence of uranium, even when present in relatively large quantities. Be, Ce, La, Th, P, Ni, Fe, Mn, Cu, Sr, Cd, Mg, B, Se, Cs, Zn, Ba, Li, and Si caused quenching of the luminescence when present in very large quantities. Ag, Hg, Pb, Bi, Cr, and Co had a strong quenching effect even when present in quantities amounting to only a few tenths of a percent of the weight of the bead. Ca, Al, Tl, and Sn gave an intensification of the luminescence or a change in its color. Ce, V, Nb, Ta, and Sb showed intrinsic luminescence in sodium fluoride. (M.C.G.)

15509 (AEC-tr-4376(p.162-6)) X-RAY DIFFRACTION STUDY OF NORTHERN KARELIAN CARBURANES. V. V. Kurbatov. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 7: 144-8(1956).

An x-ray study was made of carburanes from Northern Karelia, the x-ray-diffraction patterns of which were identified with those of uraninite, UO_2, and U_3O_8. A description is given of the five mineral specimens analyzed. A characteristic property of the carburane diagrams, and one that apparently distinguishes them from the diagrams of the uranites and UO_2, was the heavy fogging over the entire area of the film with a clearly defined central spot 25 to 30 mm in diameter. This fog apparently appeared as a result of the presence of carbon or amorphous uranium oxides in the carburanes. It was found that the lesser the degree to which the mineral is modified, the higher the probability that uranium occurs in it in a crystalline form. (M.C.G.)

15510 (AEC-tr-4523) SOME PATTERNS OF BEHAVIOR IN THE FORMATION OF BINARY-SYSTEM CONSTITUTION DIAGRAM TYPES. S. D. Gramakov. Translated from Zhur. Fiz. Khim., 24: 641-9(1950). 12p.

The phase diagrams of binary systems containing alkali metal halides were reviewed with respect to possible behavior patterns. The binary systems studied included AgX-MX, $MgCl_2$-MX, $MnCl_2$-MX, $CdCl_2$-MX, $CaCl_2$-MX, $SrCl_2$-

X, $BaCl_2$-MX, and PbX_2-MX, where X = halogen and M = kali metal. The following binary systems were investiated experimentally and found to confirm the behavior patrns observed from the phase diagrams: $CaCl_2$-RbCl, Cl_2-RbCl, $BaCl_2$-RbCl, $PbBr_2$-LiBr, $PbBr_2$-NaBr, $PbBr_2$-Br, $PbBr_2$-RbBr, $PbCl_2$-CsCl, $CdCl_2$-LiCl, $CdCl_2$-RbCl, ıd $MnCl_2$-RbCl. (D.L.C.)

5511 (TT-922) THE INFLUENCE OF MASS AND EAT TRANSFER PROCESSES ON THE ETHYLENE OXIATION REACTION RATE. M. G. Slin'ko. Translated y G. Belkov from Khim. Prom., No. 3, 10-18(1958). 30p.

The influence of mass and heat transfer processes on the eaction rate in obtaining ethylene from ethylene and air on ilver catalysts was investigated. The parameters deterıining the kinetic region and the boundaries of transition) the region of external diffusion were determined. The ffects of transfer to the outer surface of the catalyst rains and of transfer to the inner surfaces were calcuated. It was found that to achieve the regime of the kinetic egion it is necessary that the coefficient of mass transfer e greater than the reaction rate constant of complete ethlene oxidation by a factor of 180. The conditions necessary or a steady state process in the oxidation of ethylene in the inetic region were determined. (M.C.G.)

5512 THE MOLECULAR WEIGHT AND AGGREGATION OF DNA. Liebe F. Cavalieri, Joan F. Deutsch, and Barbara H. Rosenberg (Cornell Univ. Medical Coll., New York). Biophys. J., 1: 301-15(Mar. 1961).

The effects of enzymatic attack and of shear during the solation and deproteinization of DNA have been investigated. Different methods of disaggregating DNA have been studied, ınd conditions under which reaggregation can occur are liscussed. It was found that shaking with chloroform-octanol does not degrade DNA from the seven sources studied; that light scattering yields valid weight-average molecular weights for these samples; and that, when disaggregated, the molecular weights of these samples are in he range 1.2 to 2.4 million and the length-to-mass ratios are high. (auth)

15513 THE REPLICATION OF DNA. I. TWO MOLECULAR CLASSES OF DNA. Liebe F. Cavalieri and Barbara Hatch Rosenberg (Cornell Univ. Medical Coll., New York). Biophys. J., 1: 317-22(Mar. 1961).

Two classes of DNA have been distinguished on the basis of their reaction to heating in cesium chloride. DNA from proliferating sources is cleaved in half by such treatment, whereas DNA from non-proliferating sources is unaffected in molecular weight. This has been shown by two independent techniques. The relationship between the molecular units produced by cesium chloride treatment and the units conserved during DNA replication is discussed. (auth)

15514 THE REPLICATION OF DNA. II. THE NUMBER OF POLYNUCLEOTIDE STRANDS IN THE CONSERVED UNIT OF DNA. Liebe F. Cavalieri and Barbara Hatch Rosenberg (Cornell Univ. Medical Coll., New York). Biophys. J., 1: 323-36(Mar. 1961).

The kinetics of degradation of DNA by deoxyribonuclease II have been studied, using the techniques of light scattering, viscosity, and titration. Theoretical equations have been derived for both random and non-random attacks, and all assumptions have been evaluated. It has been shown that these equations permit a valid calculation of the number of polynucleotide strands per molecule. The results have been verified by two independent experimental methods. DNA from proliferating sources was found to be four-stranded; DNA from non-proliferating sources was found to be two-stranded. The implications of these findings are discussed. (auth)

15515 THE REPLICATION OF DNA. III. CHANGES IN THE NUMBER OF STRANDS IN E. COLI DNA DURING ITS REPLICATION CYCLE. Liebe F. Cavalieri and Barbara Hatch Rosenberg (Cornell Univ. Medical Coll., New York). Biophys. J., 1: 337-51(Mar. 1961).

DNA has been isolated from synchronized cultures of E. coli 15_{T-} at various times. At first the DNA was four-stranded and indistinguishable in all respects from log phase E. coli DNA, but at the start of DNA synthesis the DNA was found to have halved its molecular weight and to have become two-stranded. This sample had all the properties of undenatured, double-helical DNA, and behaved in all respects like DNA from non-proliferating sources. The replication cycle of the DNA molecule has thus been shown to consist of an alternation between the four- and two-stranded forms, the latter being the conserved unit. The evidence with respect to DNA and chromosomal structure and replication is discussed and summarized. (auth)

15516 Pi BONDING IN URANYL ION. R. Linn Belford and Geneva Belford (Univ. of Illinois, Urbana). J. Chem. Phys., 34: 1330-2(Apr. 1961).

Overlap integrals were calculated for possible primary bonds of uranyl ion. The 6d σ and π overlaps are about the same and so great that considerable bonding of σd and πd types is indicated. The 5f σ and π overlap integrals are about the same and quite small, but strong σf bonding cannot be ruled out. (auth)

15517 REFLECTANCE SPECTRA OF TERBIUM OXIDES IN THE RANGE Tb_2O_3 TO Tb_4O_7. F. Vratny (Purdue Univ., West Lafayette, Ind.). J. Chem. Phys., 34: 1377-9(Apr. 1961).

The diffuse reflectance spectra of terbium oxides (TbO_x) were studied in the composition range $1.5 \leq x \leq 1.75$ from 300 to 1500 mμ. An ultraviolet cutoff was observed at about 325 mμ. A general decrease in reflectance was observed for an increase in the oxygen to metal ratio. A band was also noted in the 380- to 400-mμ region. (auth)

15518 $n \rightarrow \pi^*$ ELECTRONIC TRANSITION IN PURE ALKALI NITRATE MELTS. G. Pedro Smith and Charles R. Boston (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 34: 1396-1406(Apr. 1961).

The lowest-energy transition ($n \rightarrow \pi^*$) of the nitrate ion was found to shift in energy and intensity in a systematic way over the series of molten alkali nitrates from $LiNO_3$ through $CsNO_3$. The energy E of the band maximum varied in a linear way with the cationic radius. At 365°C (extrapolated for $CsNO_3$) E in electron volts was given by $(3.81 + 0.33/r_0)$, where r_0 is the cationic radius (Ahrens) in A. The temperature dependence dE/dT was of the order of -10^{-4} ev/deg and increased in magnitude with increasing cationic $1/r_0$. The f number (oscillator strength) decreased steadily along the series of alkali nitrates from 4.1×10^{-4} for $LiNO_3$ down to 0.86×10^{-4} for $RbNO_3$ and then rose again to 1.0×10^{-4} for $CsNO_3$. The thermal coefficient (1/f) (df/dT) was in the range of 10^{-4} to 10^{-3} deg^{-1}. The bandwidth changed by only a small amount for changes either in cation or in temperature. The origin of the observed shifts was considered in terms of interionic cohesive forces by application of the Franck-Condon and conservation of energy principles to a localized transition in a classical ionic melt. Digital computer procedures for profile analysis were described whereby an absorption band may be separated from an overlapping absorption edge. (auth)

15519 ELECTRON NUCLEAR DOUBLE RESONANCE IN IRRADIATED ORGANIC CRYSTALS. T. Cole, C. Heller,

and J. Lambe (Ford Motor Co., Dearborn, Mich.). J. Chem. Phys., 34: 1447-8(Apr. 1961).

The electron nuclear double resonance (ENDOR) spectrum in irradiated single crystals of succinic acid is shown with the magnetic field along the b axis. At 14.2 Mc the intense line obscuring the CH proton is due to depolarization ENDOR. (N.W.R.)

15520 DISSOCIATION ENERGIES OF DIATOMIC MOLECULES. G. R. Somayajulu (Univ. of California, Berkeley). J. Chem. Phys., 34: 1449-50(Apr. 1961).

A general discussion of relations applying to the dissociation energies of diatomic molecules is presented. The application of the S-S bond is used in showing the validity of the function $U = ar^{-m} - br^{-n}$ as presented in previous reports. (N.W.R.)

15521 ELECTRON SPIN RESONANCE AND OPTICAL SPECTRA OF CHROMIUM "SANDWICH" COMPOUNDS. R. D. Feltham (Univ. of California, Berkeley). J. Inorg. & Nuclear Chem., 16: 197-203(Feb. 1961). (In English)

The visible, ultra-violet, and electron spin resonance spectra of the chromium dibenzene cation and similar ions are presented. The hyperfine splittings of 3.5–4.0 G and 20 G are attributed to the hydrogen and chromium-53 nuclei respectively. These spectra are discussed in terms of a molecular orbital theory. (auth)

15522 DEUTEROFLUOBORIC ACID AND NITRON DEUTEROTETRAFLUOROBORATE. THE STRUCTURE OF NITRON SALTS. G. A. Olah (Dow Chemical of Canada, Sarnia, Ont.). J. Inorg. & Nuclear Chem., 16: 225-32(Feb. 1961). (In English)

Deuterofluoboric acid was prepared from deuteroboric acid and deuterium fluoride or anhydrous silver tetrafluoroborate and deuterium chloride. It was analyzed in the form of the insoluble nitron–DBF_4 salt. A structural investigation of the salt resulted in suggesting an aromatic triazolium tetrafluoroborate structure. Similar structures are proposed for other nitron salts used in inorganic analytical chemistry. (auth)

15523 RHENIUM CO-ORDINATION COMPOUNDS. I. HALOGENOTRIPHENYLPHOSPHINERHENIUM AND HALOGENOTRIPHENYLPHOSPHINECARBONYLRHENIUM COMPOUNDS. M. Freni and V. Valenti (Universitá, Milan). J. Inorg. & Nuclear Chem., 16: 240-5 (Feb. 1961). (In English)

Using $HReO_4$ and PR_3 in ethyl alcohol, as starting material, with hydrohalic acids, the Re(III) compound $Re(PR_3)_2Cl_3$ was obtained directly with hydrochloric acid; with hydrobromic and hydroiodic acids the Re(II) compounds $Re(PR_3)_2Br_2$, $Re(PR_3)_2I_2$. The compound $Re(PR_3)_2Cl_2$ can only be obtained using a reducing reagent such as hydrazine hydrochloride, while $Re(PR_3)_2Br_3$ and $Re(PR_3)_2I_3$ can be prepared from the corresponding compounds of Re(II) by oxidation with bromine and iodine. Likewise $Re(PR_3)_2Cl_3$ can be obtained from $Re(PR_3)_2Cl_2$ with chlorine, while by reaction between $ReCl_3$ and PR_3 the compound $Re(PR_3)Cl_3$ is formed. By the reaction of carbon monoxide at high pressure with these compounds, Re(I) carbonyl derivatives have been isolated: the above mentioned chloro compounds gave $Re(PR_3)_2(CO)_2Cl$, $Re(PR_3)_2(CO)_3Cl$. $Re(PR_3)_2Br_2$ gave $Re(PR_3)_2(CO)_2Br$, and $Re(PR_3)_2(CO)_3Br$, under the same conditions, while to date, only the Re(I) monocarbonyl iodide derivative, $Re(PR_3)_2(CO)I$ has been obtained. All these compounds are diamagnetic in the solid state; but the derivatives of Re(II) have the paramagnetism corresponding to one electron spin in chloroform solution. (auth)

15524 PREPARATION, PHYSICAL PROPERTIES AND INFRA-RED STUDIES OF SEVERAL ALKYL AND ARYL PHOSPHORIC ACIDS. D. F. Peppard, J. R. Ferraro, and G. W. Mason (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem., 16: 246-56(Feb. 1961). (In English)

Several alkyl and aryl phosphoric acids of the type $(GO)_2PO(OH)$ were prepared. The physical properties of these compounds, including cryoscopic molecular weights and infra-red spectra are presented. The cryoscopic and infra-red data indicate the existence of strong intermolecular hydrogen bonding in these compounds, and it is postulated that such strong hydrogen bonding is typical of this class of acids. Attempts are made to analyze the infra-red spectra of the aryl phosphoric acids in terms of vibrations involving the phosphorus atom and those involving the benzene ring. (auth)

15525 TETRAVALENT LANTHANIDES. I. SODIUM PRASEODYMIUM(IV) FLUORIDES. L. B. Asprey and T. K. Keenan (Los Alamos Scientific Lab., N. Mex.). J. Inorg. & Nuclear Chem., 16: 260-2(Feb. 1961). (In English)

The compounds $NaPrF_5$ and Na_2PrF_6 containing tetravalent praseodymium were prepared by oxidation of the chlorides with elemental fluorine at elevated temperatures. The compounds were identified by x-ray diffraction methods. Further proof of the tetravalency of the praseodymium was obtained by absorption spectrophotometry and by iodometry. (auth)

15526 ISOTOPIC TRACER STUDIES ON THE THERMAL DECOMPOSITION OF URANIUM PEROXIDE. G. Gordon and H. Taube (Univ. of Chicago). J. Inorg. & Nuclear Chem., 16: 268-71(Feb. 1961). (In English)

Isotopic tracer studies using O^{18} show that on the decomposition of $UO_4 \cdot 2H_2O$, the oxygen formed originates entirely in the peroxide, and that water is liberated without contamination by "uranyl" or "peroxide" oxygen. The second observation shows that only the oxide formed on decomposition of O_2^{2-} is incorporated into the product UO_3, and also proves that $UO_3 \cdot H_2O_2 \cdot H_2O$ is not a proper constitutional formula of the peroxide. The conclusions summarized depend on observations for systems in which only partial decomposition has taken place. The products do inter-equilibrate readily, and samples removed after complete decomposition show evidence of this. (auth)

15527 THE URANIUM(V)-CATALYSED EXCHANGE REACTION BETWEEN URANYL ION AND WATER IN PERCHLORIC ACID SOLUTION. G. Gordon and H. Taube (Univ. of Chicago). J. Inorg. & Nuclear Chem., 16: 272-8(Feb. 1961). (In English)

The exchange reaction between UO_2^{2+} and H_2O was studied at 25°. A method using ferrocyanide ion is described for the direct sampling of uranyl ion. The exchange reaction is catalyzed by UO_2^+ which disproportionates with a second order dependence on UO_2^+. The value of the specific rate appropriate to the rate law $-d(UO_2^+)/dt = k(H^+)(UO_2^+)^2$ is found to be 435 at $\mu = 1.58$. A mechanism for the exchange reaction is proposed and a minimum value for the rate of electron exchange between U(V) and U(VI) is given. Data for the uncatalyzed reaction are also given. (auth)

15528 THE THERMAL DECOMPOSITION OF LANTHANUM OXALATE. A. Glasner and M. Steinberg (Hebrew Univ., Jerusalem). J. Inorg. & Nuclear Chem., 16: 279-87 (Feb. 1961). (In English)

Anhydrous lanthanum oxalate is stable at 320°C. On heating this salt at higher temperatures intermediates are produced which appear to correspond to definite compositions, but they are contaminated with finely dispersed car-

n. The course of the decomposition in vacuum, as fol-wed by measuring the increase of pressure, is typical some branching chain reactions in solids, and Prout and mpkins' equation applies. The constant high proportion carbon dioxide in the evolving gases, the infra-red ectra of the solid residues and other experimental re-lts, are explained by the initial conversion of the oxalate to carbonate and carbon monoxide. The latter dispro-rtionates into carbon dioxide and carbon, under the high essure existing in the channels through which the gases rge out of the decomposing crystallites. The composi-ons of the intermediates obtained at temperatures up to 20°C are given. The activation energy of the initial de-mposition of the oxalate is 31.7 kcal/mole. (auth)

15529 STUDIES ON TTA COMPLEXES WITH METAL NS. I. SPECTROPHOTOMETRIC AND POTENTIOMET-IC INVESTIGATIONS ON URANYL COMPLEXES. K. M. bubacker and N. S. Krishna Prasad (Atomic Energy Es-blishment, Trombay, India). J. Inorg. Nuclear Chem., 6: 296-307(Feb. 1961). (In English)

The nature and composition of the uranyl-TTA complex n an aqueous alcoholic medium were investigated by spec-rophotometric and potentiometric methods. The intensity f the color of the complex is dependent on the pH and the lcoholic content of the medium. Spectrophotometric stud-es, which could only be extended to a maximum concen-ration of 1×10^{-4} M uranium, show that in dilute solutions he complex has the composition UO_2^{2+} : TTA = 2 : 3 whereas n concentrated solutions the potentiometric studies indi-ate that this ratio is 1 : 2. Chemical analysis of the solid omplex also indicates a ratio of 1 : 2. A possible structure or the 2 : 3 complex is proposed. (auth)

15530 ION EXCHANGE IN MIXED SOLVENTS. V. THE DISTRIBUTION OF THORIUM BETWEEN ALCOHOL–NITRIC ACID SOLUTIONS AND THE STRONGLY-BASIC ANION EXCHANGER DOWEX-1. SEPARATION OF THORIUM FROM URANIUM. F. Tera, J. Korkisch, and F. Hecht (Universität, Vienna). J. Inorg. & Nuclear Chem., 16: 345-9(Feb. 1961). (In English)

A rapid and accurate means of separating thorium and uranium was developed. Experiments have shown that the adsorption of thorium as a negatively-charged nitrate com-plex on strongly-basic anion exchangers from solutions containing aliphatic alcohols and nitric acid is very high compared with its adsorption from pure nitric acid solu-tions devoid of any organic solvent. After determining the distribution coefficients of thorium and uranium in nitric acid solutions containing aliphatic alcohols it was possible to develop a method for the separation of thorium from uranium by means of anion exchange. (auth)

15531 FLUORINE NUCLEAR SPIN RESONANCE SPECTROSCOPY. IV. A SILICON-29 ISOTOPE EFFECT. G. V. D. Tiers (Minnesota Mining and Mfg. Co., St. Paul). J. Inorg. & Nuclear Chem., 16: 363-5(Feb. 1961). (In English)

When fluorine is attached to silicon-28 or silicon-29, an isotope effect is observed which consists of a shift of the fluorine nuclear spin resonance peak center in the direction of greater shielding, relative to the corresponding peak due to the fluosilicate. The isotope effects are given in a table which shows the excess fluorine nuclear spin resonance shielding produced by silicon-29 in aqueous ammonium fluosilicate solutions. (N.W.R.)

15532 CONTRIBUTION TO A STUDY OF OXIDATION OF URANIUM IN CARBON DIOXIDE AT ELEVATED TEMPERATURES. J. Paidassi, M. L. Pointud, R. Caillat, and R. Darras (Centre d'Etudes Nucleaires, Saclay, France). J. Nuclear Materials, 3: 162-74(Feb. 1961). (In French)

Specimens of mechanically polished reactor grade uranium were treated at 100 to 700°C in carbon dioxide, very carefully purified from oxygen and water vapor, and their oxidation was followed simultaneously by gravimetry and by micrography. The plots of weight gain as a function of time are sensibly linear, but in the range 550 to 700°C they have some breaks, which is partly attributable to the enlargement of the samples during oxidation. In the range 200 to 400°C, roughly circular oxide "nuclei" form upon a very thin, continuous oxide film. These nuclei are distinctly thicker than the film, and between 400 and 500°C they turn into blisters. Nuclei and blisters form preferentially on polishing scratches and on certain inclusions, probably carbides. Near the blisters, the metal undergoes pronounced plastic deformation which results in cracking of the previously continuous thin film. When the oxidation temperature exceeds 600°C, the blisters retreat considerably, but the whole specimen now deforms and grows, which leads to pronounced cracking of the scale. (auth)

15533 THE HIGH TEMPERATURE OXIDATION OF BERYLLIUM. PART III. IN CARBON DIOXIDE, CARBON MONOXIDE AND CARBON MONOXIDE–CARBON DIOXIDE MIXTURES. S. J. Gregg, R. J. Hussey, and W. B. Jepson (The University, Exeter, Eng.). J. Nuclear Materials, 3: 175-89(Feb. 1961). (In English)

The kinetics of the oxidation of electrolytic flake beryllium in carbon dioxide, in carbon monoxide and in carbon monoxide-carbon dioxide mixtures were measured at temperatures from 500° to 750°C. In carbon dioxide, at temperatures up to 700°C, the rate of oxidation continuously decreases with time to reach a very small value (e.g., at 700°C, 0.13 $\mu g/cm^2$ h after 300 h) while at 750°C the rate first decreases and then increases, indicating breakaway. If the carbon dioxide is admitted to the preheated sample the oxidation is very rapid at first and most of the carbon deposition occurs over the initial period. In carbon monoxide, the oxidation is non-protective above 550°C, the rate of oxidation being considerably greater than in carbon dioxide. When beryllium is heated at 650°C in carbon monoxide-carbon dioxide mixtures containing up to 7.5% of carbon monoxide, the kinetics are the same as in pure carbon dioxide. (auth)

15534 THE HIGH TEMPERATURE OXIDATION OF BERYLLIUM. PART IV. IN WATER VAPOUR AND IN MOIST OXYGEN. D. W. Aylmore, S. J. Gregg, and W. B. Jepson (Univ. of Exeter, Eng.). J. Nuclear Materials, 3: 190-200(Feb. 1961). (In English)

The kinetics of the oxidation of electrolytic flake beryllium both in water vapor (1.2 cm pressure) and in moist oxygen (10 cm total pressure; partial pressure of water, 1.2 cm) have been investigated at temperatures in the range 500° to 750°C; there was no significant difference between oxidation in these two gases. At temperatures up to and including 600°C the oxidation follows the same course as in dry oxygen, the rate continuously decreasing with time to reach a very small value after about 100 h. At 650°C and above, the oxidation is no longer protective and breakaway takes place, both the weight gain and the time at which breakaway occurs becoming less with increasing temperature. Metallographic examination of partially oxidized samples shows that the reaction after breakaway takes the form of attack down the particle boundaries giving rise to an interpenetrating network of oxide and metal. The effect of an oxide layer pre-formed in dry oxygen is shown to re-

tard but not prevent breakaway on subsequent exposure to water vapor. (auth)

15535 THE COMPATIBILITY OF BERYLLIUM AND URANIUM DIOXIDE. A. G. Knapton and K. B. C. West (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). J. Nuclear Materials, 3: 239-40(Feb. 1961). (In English)

Results of reaction rate studies of beryllium with uranium dioxide from 500 to 800°C are graphically and tabularly presented. For comparison with other reaction rates of beryllium systems the rates of beryllium with iron, nickel, stainless steel, and uranium are given. (N.W.R.)

15536 AN ION EXCHANGER FOR THE PURIFICATION OF RADIOACTIVELY CONTAMINATED WATER. R. Winkler (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 3: 1195-7(Dec. 1960). (In German)

A cation exchanger of sufficiently stable construction was manufactured from bentonic clay and high-moor peat. The selective properties of the components, which are left unchanged, make it specially suitable for the purification of waste water containing fission products. The raw materials for the manufacture of the exchanger are inexpensive and easily obtainable. Therefore regeneration and further utilization can be relinquished. (tr-auth)

15537 THE PRECIPITATION OF NIOBIUM OXINATE OF DEFINITE COMPOSITION. L. Kosta and M. Dular (Nuclear Inst. "Jožef Stefan," Ljubjana, Yugoslavia). Talanta, 8: 265-9(Apr. 1961). (In English)

Since the composition of niobium oxinate, precipitated from aqueous solution, is apparently not definitely established, several new techniques were used for the preparation of a compound of definite composition. Of these techniques, homogeneous precipitation of niobium oxinate by means of urea yielded the best results. The product is crystalline and agrees, within the limits of ±0.5%, with the theoretical formula $NbO(C_9H_6ON)_3$. Furthermore, the solubility in various organic solvents, the spectrum in the ultraviolet and infrared regions, and the electron diffraction were determined; thermolysis was carried out; and photomicrographs of the crystals were taken. (auth)

15538 C^{13} ISOTOPE EFFECT IN THE PROTON RESONANCE OF ORGANIC COMPOUNDS. H. Dreeskamp and E. Sackmann (Technische Hochschule, Stuttgart). Z. physik. Chem. (Frankfurt). 27: 136-8(Jan. 1961). (In German)

C^{13} has spin $\frac{1}{2}$ and causes a doublet splitting of the proton resonance signal. It can also be shown that C^{13} also causes a chemical displacement of the proton signal. The proton signals of C^{13} do not lie symmetrically around the principal signal from C^{12}, but are displaced considerably to stronger fields. The isotopic shift in acetaldehyde is shown as an example. The results obtained for the chemical shift of proton resonance are tabulated for the compounds studied. The error of the measurements is $\pm 0.0005 \times 10^{-6}$. (J.S.R.)

15539 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF COMPOUNDS OF TRIVALENT URANIUM. (to E. I. du Pont de Nemours and Co.). British Patent 865,270. Apr. 12, 1961.

An economical and low-temperature method is given for preparing solutions of uranium(III) compounds uncontaminated with uranium of other valencies, and for preparing solid UF_3. The method consists of quantitatively reducing >90% uranium compounds to uranium(III) compounds by zinc amalgam under certain critical reaction conditions and then precipitating UF_3 by mixing the solution with a fluoride solution. A uranium compound of valency higher than 3 is dissolved in an acidic aqueous solution of hydrogen ion concentration 0.5 to 2 M to form a solution of uranium concentration ≤0.2 M, and the solution is reduced by zinc amalgam in the absence of O_2 and anions capable of forming stable uranium(IV) complexes. Acids and uranium compounds which do not contain complexing anions may be used. In the precipitation of UF_3, the uranium(III) solution should be added to the fluoride solution and not vice versa, and the amount of fluoride should be between 1 and 3 times the stoichiometric amount required for UF_3. (D.L.C.)

Analytical Procedures

15540 (AAEC/E-60) SPECTROPHOTOMETRIC DETERMINATION OF CALCIUM WITH GLYOXAL BIS (2-HYDROXY-ANIL). T. M. Florence and Julie Morgan (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Mar. 1961. 4p.

A selective method is described for the spectrophotometric determination of calcium using glyoxal bis(2-hydroxy-anil) as the chromogenic agent. A comprehensive study of interferences and reagent variables was made. (auth)

15541 (AE-51) ACTIVATION ANALYSIS OF ALUMINUM. Dag Brune (Aktiebolaget Atomenergi, Stockholm). Jan. 1961. 8p.

An analysis of aluminum alloyed with magnesium was performed by gamma spectrometry. Chemical separations were not employed. The isotopes to be determined were obtained in conditions of optimum activity by suitably choosing the time of irradiation and decay. The following elements were detected and measured quantitatively: iron, zinc, copper, gallium, manganese, chromium, scandium, and hafnium. (auth)

15542 (AERE-AM-72) THE COULOMETRIC DETERMINATION OF BORIC OXIDE IN HEAVY WATER. A. Parker and E. A. Terry (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Jan. 1961. 4p.

In determination of boric oxide in heavy water, the boric oxide solution was neutralized by the electrogeneration of OD^- and OH^- ions in situ and the progress of the reaction followed potentiometrically. The method is based on the assumptions that the acidity of the solution to be analyzed is due solely to the D_3BO_3 content and that the solution does not contain any significant amount of any ion which is more easily reduced than the deuterium ion in the pH range from 3 to 9. The method was found to be free from bias and at the 25 mg B_2O_3 level had a coefficient of variation of 0.3% on a single determination. (auth)

15543 (AERE-R-3576) LARGE ISOTOPE SHIFTS IN THE PLUTONIUM SPECTRUM AND THEIR SUITABILITY FOR ISOTOPE ANALYSIS. E. W. T. Richards and A. Ridgely (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Dec. 1960. 7p.

The plutonium spectrum was photographed in the region 2950 to 5750 A, and this region subsequently was studied for large isotope shifts. It was found that the abundance of large shifts increased sharply with increasing wavelength. Above 5000 A shifts of greater than 0.060 A tended to become the rule rather than the exception. Two lists of lines suitable for isotope analysis were prepared: one below 5000 A and the other above. (M.C.G.)

15544 (AERE-R-3605) THE IDENTIFICATION OF BETA-EMITTING ISOTOPES BY LIQUID SCINTILLATION

UNTING. W. P. Hutchinson (United Kingdom Atomic ergy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 30. 9p.

The average energy of a beta-emitting isotope, in microcrocurie amounts, may be measured at room temperae by the system described. The apparatus is useful for oid, quantitative, routine analysis of beta-emitters reired for biological purposes. The spectrometer is a nplified apparatus using standard equipment. (auth)

5545 (BLG-55) ANALYSE DES FORMES SOUS LESJELLES L'IODE-132 APPARAIT LORSQU'IL EST SEPARE JE TELLURE-132 PAR CHROMATOGRAPHIE SUR ALUINE. (Analysis of Various Forms of Iodine-132 When parated from Tellurium-132 by Chromatography on Aluina). R. Stiennon-Bovy and G. Geladi (Brussels. Centre l'Energie Nucleaire). Dec. 1, 1960. 15p.

By paper chromatography (methanol, ethanol) and ion exange determinations were made of various forms of dine-132 when it is separated by a 10^{-2}N NH_4OH solution om its parent tellurium-132 which is adsorbed on an alina column. The results obtained by the methods agree ll, the iodine-132 appears for more than 97% in the form iodide. (auth)

5546 (CEA-1706) DOSAGE FLUORIMETRIQUE DE URANIUM URINAIRE. (Fluorimetric Determination of anium in Urine). Claude Ronteix and Gilbert Hugot rance. Commissariat à l'Énergie Atomique. Centre Etudes Nucléaires, Saclay). 1960. 19p.

For the medical supervision of personnel the most sensive analytical methods must be used. The fluorimetric ethod enables determinations of uranium to be made witht previous concentration and is undoubtably the quickest id most effective. This report is intended to help users the method to avoid loss of time in the practical applition. It describes in great detail the material used and so gives precise technical information acquired by experince. (auth)

5547 (HW-53368) ANALYTICAL TECHNICAL ANUAL. R. A. Schneider and K. M. Harmon, eds. eneral Electric Co. Hanford Atomic Products Operation, ichland, Wash.). Feb. 1, 1961. Contract AT(45-1)-1350. 32p.

Descriptions are given of: alpha counting methods; determination of Am^{241} by TBP-TTA extraction; emission spectographic determination of impurities in materials; determination of HNO_3 in chemical reagents and process solutions; eparation of Np^{237} by TTA extraction; determination of utonium (IV) by TTA extraction; analytical solvent extraction; determination of specific gravity by falling drop ethod; fluorimetric determination of uranium; and x-ray psorptiometric determination of plutonium and uranium. B.O.G.)

5548 (IEA-7) SIMULTANEOUS DETERMINATION F GOLD AND URANIUM IN ORES BY RADIOACTIVATION NALYSIS. Alcidio Abrão (São Paulo, Brazil. Universidade. Instituto de Energia Atomica). 1959. 17p.

A method for the simultaneous determination of gold and ranium in ores was developed using activation analysis nd ion exchange techniques. The elements were determined by means of the radioisotopes Au^{198} and Np^{239} formed y irradiating the ore in a neutron flux. Gold was separated rom neptunium and fission products using a strong anionic esin, without the addition of a gold isotopic carrier. The fficiency of the separations and the purity of the isolated adioisotopes were checked by gamma spectrometry and easurements of half-lives. (M.C.G.)

15549 (IGO-TM/S-028) THE DETERMINATION OF TRACE AMOUNTS OF THORIUM IN URANIUM. A. H. Helman and A. L. Wilson (United Kingdom Atomic Energy Authority. Industrial Group. Springfield Works, Springfields, Lancs, England). Feb. 6, 1958. 6p. (IGC-ARDC/P-285)

Carrier-free Th^{234} was obtained from uranium in a 7M HCl solution by passage through a column of Deacidite FF anion exchange resin and elution with acid of the same concentration. The procedure was used for the determination of microgram amounts of thorium in uranium. The eluate from the column was concentrated and the thorium precipitated with calcium as the oxalate. The precipitate was then ignited and its thorium content determined spectrographically. (auth)

15550 (JAERI-4013) ANALYSIS OF URANIUM AND THORIUM: A BIBLIOGRAPHY. Report No. 13. Kenji Motojima, Hiroshi Onishi, Hiroshi Hashitani, et al. (Japan Atomic Energy Research Inst., Tokyo). 1959. 116p.

A bibliography is presented, consisting of 714 references published 1946 through 1958, relating to the separation and determination of elements in thorium, uranium, their alloys, and compounds. (B.O.G.)

15551 (JAERI-4017) ANALYSIS OF URANIUM AND THORIUM. A BIBLIOGRAPHY (II). Report No. 17. K. Motojima, H. Onishi, H. Hashitani, et al. (Japan Atomic Energy Research Inst., Tokyo). Oct. 12, 1960. 91p.

A supplemental bibliography is presented, consisting of 556 references published during 1959, relating to the separation and determination of elements in thorium, uranium, their alloys, and compounds. (For bibliography I, see JAERI-4013.) (B.O.G.)

15552 (ORO-334) AN INVESTIGATION OF AUTOMATED ACTIVATION ANALYSIS. Quarterly Progress Report. L. E. Fite, W. M. Breen, W. B. Heye, J. E. Anderson, W. L. Sanders, J. Shanks, and R. E. Wainerdi (Texas. Agricultural and Mechanical Coll., College Station. Engineering Experiment Station). Nov. 1, 1960. 25p. Contract AT(40-1)-2671. Project No. 1.

A completely automated system for neutron activation analysis without loss in sensitivity is discussed. The development of devices to demonstrate automated techniques, and the study of optimization of the various components of the system are reported. (W.L.H.)

15553 (ORO-377) AN INVESTIGATION OF AUTOMATED ACTIVATION ANALYSIS. Quarterly Progress Report, May 1–August 1, 1960. L. E. Fite, S. M. Breen, W. B. Heye, J. E. Anderson, W. L. Sanders, S. A. Sims, and R. E. Wainerdi (Texas. Agricultural and Mechanical Coll., College Station. Engineering Experiment Station). Aug. 1, 1960. Contract AT-(40-1)-2671. 18p. (E 71-60)

A method of removing information from the magnetic core memory located in a multichannel analyzer and putting it into form so that it could be used by an analog or digital computer is described. A DYMEC Computer Coupler and Tape Punch Unit was installed to read the information in the analyzer's memory and put it on punched tape. The data can then be transferred to punched cards by the use of a converter. It was previously shown that qualitative and quantitative elemental analysis can be performed by digital computers. Therefore a number of different samples were prepared for activation and analysis to determine the accuracy and ability of the computer program and to test modifications of it. An alternate method of machine analysis called "curve fitting" was also studied. System engineering considerations are also discussed. (M.C.G.)

15554 (PG-Report-181) ANALYTICAL METHOD FOR THE POLAROGRAPHIC DETERMINATION OF ZINC IN MAGNOX ALLOY. (United Kingdom Atomic Energy Authority. Production Group. Windscale, Sellafield, England). 1961. 6p.

A method for the determination of zinc in magnox alloys is described. After extraction into a CCl_4 solution of dithizone, the zinc was back extracted with dilute HCl. The extract was evaporated to dryness, the residue wet oxidized to remove organic matter, dissolved in pyridine–pyridinium chloride base solution, and the zinc content measured by an a-c polarographic technique. The technique can be applied to zinc in the concentration range from 10 to 200 μg. It was found that the detection limit could be lowered further by using a polarographic microcell. The method is applicable to magnesium–aluminum alloys containing beryllium in very low proportions. (M.C.G.)

15555 (TID-6870(Pt.III)) ANALYTICAL PROCEDURE FOR THE DETERMINATION OF ACTINIUM IN URANIUM PROCESS SAMPLES. Final Report–Part III. Henry G. Petrow, Robert J. Allen, Robert Lindstrom, and Bernard Sohn (Ionics, Inc., Cambridge, Mass.). Apr. 11, 1961. Contract AT(30-1)-2470. 15p.

A procedure for the determination of Ac^{227} in mill effluents was developed and tested. Actinium was concentrated by extraction with di (2-ethylhexyl) phosphoric acid (EHPA). It was found that the actinium could be strongly extracted at acid concentrations less than 0.1M. Pb, Ca, Mn, Mg, V, and the light rare earths were also extracted under these conditions. A chemical procedure for the determination of Ac^{227} is presented. The final precipitate was counted over a period of days to observe the in-growth of the daughter products from which the actinium concentration was obtained using calculated values from the Bateman equation. The accuracy and precision of the analyses were satisfactory. Elimination of rare earths from the actinium mount greatly increased the precision of the analysis. The application of the procedure to the analysis of solid samples was studied. (M.C.G.)

15556 (TID-6904) THEORETICAL BASIS FOR KINETIC EFFECTS IN GAS-SOLID CHROMATOGRAPHY. J. Calvin Giddings (Utah. Univ., Salt Lake City. Dept. of Chemistry). Nov. 2, 1960. 3p. Contract AT(11-1)-748.

Lateral diffusion in the gas phase as well as sorption-desorption kinetics may both influence the plate height of gas-solid chromatography (GSC). While the complicated nature and alignment of absorbing surfaces in a column cannot be fully described mathematically, a model is presented which allows for the fundamental diffusion and reaction processes of GSC. The theory is written in a general form which can be readily extended to more complex phenomena. (W.L.H.)

15557 (WAPD-T-904) THE APPLICATION OF QUINALIZARIN TO THE DETERMINATION OF BORON IN SHIPPINGPORT PRESSURIZED WATER REACTOR MATERIALS. G. W. Goward, L. Jimenez, D. Reed, T. M. Reinhold, and V. R. Wiederkehr (Westinghouse Electric Corp. Bettis Plant, Pittsburgh). December 23, 1958. 29p. Contract AT-11-1-GEN-14.

Quinalizarin methods are reported for determining boron in U–Zr alloys, uranium oxides, and aluminum base materials. (W.L.H.)

15558 (AEC-tr-4376(p.120-4)) A FLUORIDE METHOD FOR SEPARATING SMALL QUANTITIES OF URANIUM WITH SUBSEQUENT POLAROGRAPHIC DETERMINATION. I. E. Starik, F. E. Starik, and A. N. Apollonova. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 7: 107-10 (1956).

Thorium salts were used as carriers for the separation small quantities of uranium from associated elements by coprecipitation in the form of fluorides. Polarography of the uranium was then carried out in the presence of the thorium. Zinc was used to reduce the uranium to the tetravalent state before precipitation. Experiments conducted with standard solutions of uranium indicated that uranium in quantities of 10^{-4} to 10^{-5} g is completely redu and completely precipitated with thorium fluoride. This was verified by the polarographic method. (M.C.G.)

15559 (AEC-tr-4376(p.125-8)) A NEW TYPE OF ANALYSIS FOR SMALL QUANTITIES OF Cr^{+++} BASED ON DETERMINATION OF THE DEGREE OF QUENCHING OF THE LUMINESCENCE OF URANIUM. I. E. Starik, F. E. Starik, and G. B. Kostyrev. Translated from Trudy Radie vogo Inst. im. V. G. Khlopina, 7: 111-13(1956).

An analysis for chromium based on determination of the degree to which it quenches uranium luminescence is described. Linearity was established for the quenching of uranium luminescence in sodium fluoride beads containing 8×10^{-9} g of uranium as a function of the logarithm of the chromium concentration. Quenching was found to begin at a chromium concentration of 5×10^{-8} g and to increase gradually to total quenching at a concentration of 1×10^{-5} Measurements of the chromium content in a series of solu tions of known concentrations were made to check the accuracy of the method. It was found to be accurate to within ±15%. (M.C.G.)

15560 (AEC-tr-4376(p.142-53)) LUMINESCENCE METHOD FOR DETERMINING URANIUM WITHOUT SEPARATION OF QUENCHERS. L. Ya. Atrashenok, L. L. Voloshenko, and A. Ya. Krylov. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 7: 126-36(1956).

The conditions under which uranium may be determined by the luminescence method without separation from the associated elements were determined. Detailed studies were made of the quenching effects of Si, Ca, Al, Fe, and Co, the most widely distributed rock-forming elements. The limiting impurity concentration at which uranium luminescence was not quenched was determined by successive dilutions of the mixture. The preliminary experiments indicated that analysis of the most widely distribute varieties of rocks, ores, and minerals by the method of direct fusion with sodium chloride without any preliminary chemical processing is basically possible. A preliminary check of the method was carried out on granites, limestone and clays. The departure of the results of the uranium determination from the data of radiochemical analysis was within the limits of error of the luminescence method. The interference due to the presence of an element was found t depend on the ratio of its concentration to the uranium con centration. (M.C.G.)

15561 (AEC-tr-4376(p.154-8)) ELECTROLYTIC DEPOSITION OF SMALL QUANTITIES OF URANIUM. A. G. Samartseva. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 7: 137-40(1956).

The method of quantitative electrolytic deposition of uranium onto a platinum electrode from weakly acidic solution having pH values from 2 to 3 was refined for the deposition of small quantities of uranium using U^{233} in an HNO_3 solution. After completion of the electrolysis, the disk was washed with alcohol and fired, and measurements of the α activity made simultaneously from both sides of the disk. Results indicated that the uranium was deposited quanti-

vely from the solution. Uranium was also deposited ntitatively from solutions of H_2SO_4, HCl, $HClO_4$, and $_2O_4$ under the same conditions. Electrolytic redeposi- of the uranium from the anode to the cathode proceeded ntitatively only with small electrolyte volumes and with electrodes very close together. (M.C.G.)

62 (AEC-tr-4477) PROBLEMS OF ANALYTICAL TERMINATION OF C:C BONDS. Bretislav Budesinsky. nslated from Chem. listy, 53: 997-1028(1959). 52p.

he physical nature of C:C bonds is discussed along with r determination by chemical and physical methods. All mical methods are based essentially on addition of per agents to the C:C bond. The reactions are either nolytic or heterolytic. The hydrogenation method is the st widely used because of the high reactivity of the hy- gen and because the addition is usually a homolytic one. er methods are based on the addition of halogens and thio- nogen, reactions with peroxy acids, ozonization, oxida- n by permanganate and periodate, or other electrophilic nucleophilic additions. Qualitative methods for the de- mination of conjugated C:C bonds are based on the Siels- ler reaction. Polarography and ultraviolet and infrared ctroscopy are physical methods most widely used for ermining C:C bonds. The nature of the substance under estigation, its origin, availability of standard samples, l efficiency and accuracy required are discussed as a is for the selection of the most appropriate method for ermining the C:C bond. (373 references). (M.C.G.)

563 (AEC-tr-4551) DETERMINATION OF TRITIUM THE ATMOSPHERE. A. M. Chapuis and G. Soudain. anslated by Martha Gerrard (Oak Ridge National Lab.) m Bull. inform. sci. et tech. (Paris), No. 43, 52-7 (Sept. 60). 7p.

A program is outlined for determining tritium in atmos- eric water vapor, and to determine whether the apparatus uld be adapted to continuous measurements. The use of paratus operating with a relatively low air flow has the vantage of giving significant deviations with relatively all amounts of active gas, thus permitting calibration, d rendering useless an ion trap. (B.O.G.)

564 (JPRS-4444) SEPARATION OF STRONTIUM ROM CALCIUM BY ION-EXCHANGE IN THE PRESENCE F COMPLEX III. O. Budevski and N. Krasnoba'eva rasnobayeva). Translated from Compt. rend. acad. lgare sci., 13: No. 1, 67-70 (Jan.-Feb. 1960). 6p.

A procedure is described for separating small amounts Sr from large amounts of Ca by ion exchange in the pres- nce of ethylenediaminetetraacetic acid. A complex of Ca is rmed while the Sr remains in the form of the free ion. ata are included from a study of the optimal pH for separa- on under various conditions. Determinations of the con- ntrations of Ca and Sr were made with a flame photom- er. (C.H.)

5565 WATER ANALYSIS. M. W. Skougstad and M. J. ishman (Geological Survey, Denver). Anal. Chem., 33: 38R-64R(Apr. 1961).

A bibliography review is given on water analysis for the eriod August 1958 to August 1960. Within the scope of the eview are methods for determining alkali metals, alkaline arth metals, most of the other metals, inorganic and or- anic compounds, gases, and isotopes. (N.W.R.)

5566 SPECTROPHOTOMETRIC DETERMINATION OF BERYLLIUM, COPPER AND IRON WITH SODIUM-2'', 6''-DICHLORO-4'-HYDROXY-3, 3'-DIMETHYLFUCHSONE-5'-DICARBOXYLATE. Yukiteru Katsube (Himeji Technical Coll., Idei, Japan), Katsuya Uesugi, and John H. Yoe. Bull. Chem. Soc. Japan, 34: 72-6(Jan. 1961). (In English)

Procedures were developed for the spectrophotometric determination of trace amounts of beryllium, copper and iron(III) with sodium-2'', 6''-dichloro-4'-hydroxy-3, 3'-dimethylfuchsone-5,5'-dicarboxylate. Certain ions that interfere with the beryllium determination are removed by an oxine precipitation. Ions that interfere with the analysis of copper and iron(III) are removed with an anion exchange resin column. Accuracy and precision are good. Beer's law is obeyed up to about 0.3 ppm of beryllium, about 4 ppm of copper, and about 3 ppm of iron. (auth)

15567 RAPID SEPARATION OF NUCLIDES IN FUSION PRODUCTS AND THEIR DETERMINATIONS BY FOCUSSING CHROMATOGRAPHIC METHOD. Mutsuaki Shinagawa, Yoshiyuki Kiso, and Akira Oyoshi (Hiroshima Univ.). Bull. Chem. Soc. Japan, 34: 137-8(Jan. 1961). (In English)

Focusing chromatography is more rapid and convenient for determining the separation of nuclides in fission products than any other method known. The separation of several kinds of nuclides was accomplished in a few minutes by adjusting the pH valve between solutions of hydrochloric acid and complexing agent. The autoradiographic method was used to decide the position of separated lines. Identification of nuclides was carried out by measuring half-lives and energies. (N.W.R.)

15568 DIRECT DETERMINATION OF NIOBIUM AND TANTALUM USING THE WOFZTIT SBW ANION EXCHANGER. S. Spauszus and M. Heimer. Chem. Tech. (Berlin), 13: 96-9(Feb. 1961). (In German)

A method is given for the isolation of Nb and Ta in steels from the usual alloying constituents (with the exception of Ti), the separation of the mixed oxides obtained with the anion exchanger Wofztit SBW, and their direct determination. The separation of tungsten was tested with W^{185}, the separation of Nb and Ta with Nb^{95} and Ta^{180}. The elution constants determined were, for a Nb_2O_5/Ta_2O_5 ratio of about 49 : 1, up to 1 : 43. (tr-auth)

15569 DETERMINATION OF URANIUM AND THORIUM IN RADIOACTIVE MINERALS BY γ SPECTROMETRY. Louis Avan and Paul Keller (Faculte des Sciences, Clermont, France). Compt. rend., 252: 1135-7(Feb. 20, 1961). (In French)

The experimental method for the determination of uranium and thorium in radioactive samples is based on a single analysis of the γ spectrum. The method is applicable to any degree of disequilibrium and requires only a simple apparatus (two single-channel detectors and amplitude selector). The utilization of the method—including the elimination of the effect of β radiation, the study of the effect of γ self-absorption, and the drift of the instrument—is simple and rapid and lends itself to a wide series of measurements. (tr-auth)

15570 DETERMINATION OF URANIUM AND THORIUM IN RADIOACTIVE MINERALS BY γ SPECTROMETRY. [PART] II. Louis Avan and Paul Keller. Compt. rend., 252: 1445-7(Mar. 6, 1961). (In French)

The nature of the problems treated on a computer beginning with the experimental data previously analyzed (Compt. rend. 252, 1135(1961)) is defined. By utilizing in the measurements radioactive samples of mass less than 400 mg, the effect of self-absorption appears negligible. (tr-auth)

15571 SPECTROPHOTOMETRIC DETERMINATION IN ULTRAVIOLET. V. M. Tarayan and L. A. Eliazyan (Inst. of Geological Sciences, Academy of Sciences, Armenian SSR). Izvest Akad. Nauk Armyan. S.S.R., Khim. Nauki, 13: 245-9(1960). (In Armenian)

The maximum light absorption by cerium(III) sulfate and

pyrophosphate was found at 225 mμ for the first complex and at 305 mμ for the second; the molar light damping coefficients are ~685 and ~800 respectively. The light absorption curves were developed for cerium(IV) sulfates and pyrophosphates in the ultraviolet. The absorption maximum for the first compound was found at 320 mμ and for the second at 278 mμ. The damping molar coefficients are ~4800 and ~7500 respectively. The light absorption capacity of cerium(III) pyrophosphate complexes increases with increased pH, while the absorption maximum of cerium(IV) pyrophosphate complexes does not depend on pH. The presence of Fe and Gd interfered with the spectrophotometric separation of cerium in ultraviolet. (R.V.J.)

15572 SPECTROPHOTOMETRIC DETERMINATION OF MICROQUANTITIES OF NICKEL IN URANIUM WITH DIMETHYLGLYOXIME. Kenji Motojima, Hiroshi Hashitani, and Kazuo Katsuyama (Japan Atomic Energy Research Inst., Tokyo). J. At. Energy Soc. Japan, 3: 89-92(Feb. 1961). (In Japanese)

A spectrophotometric method is critically examined for the determination of microgram quantities of nickel in uranium with dimethylglyoxime. Nickel is determined spectrophotometrically after extracting its dimethylglyoxime complex with chloroform. Approximately 30 ml of acid solution containing not more than 2.5 g of uranium and 150 μg of nickel is treated with 10 ml of 30% ammonium citrate solution, 1 ml of 1% dimethylglyoxime solution (1 g in 100 ml of 95% ethanol), and the proper amount of ammonium hydroxide to adjust the pH to 8.8 to 10, and the volume is brought to 50 ml. Then, the nickel complex is extracted with exactly 10 ml of chloroform, and the absorbance of the extract is measured at 375 mμ using a blank as reference. By this method, as small as 5 μg of nickel in 2.5 g of uranium can be determined rapidly and accurately. The method provides for the presence of other metals. (auth)

15573 SPECTROGRAPHIC DETERMINATION OF TRACE BORON IN GRAPHITE FOR NUCLEAR REACTORS. Tokunosuke Nakajima (Japan Atomic Energy Research Inst., Tokyo), Masao Takahashi, and Masutaka Morishita. J. At. Energy Soc. Japan, 3: 104-9(Feb. 1961). (In Japanese)

Two procedures are described for the spectrographic determination of 0.002 to 3 ppm of boron in graphite. In the first method, preliminary concentration is carried out by the removal of the graphite by ashing in the presence of La_2O_3. Then the boron in La_2O_3 is determined by the carrier-distillation method. In the second method, a sample in the form of powder is compressed into pellets with the aid of a phenol-formaldehyde resin as binding medium, and the pellets are arched at 7 amp d-c. By means of display microphotometry, the peak height of B at 2497.73 A is compared with that of the NO(γ) band component at 2497.14 A. (auth)

15574 RADIOMETRIC AND AMPEROMETRIC TITRATIONS OF COPPER WITH t-ANTHRANILIC ACID. G. H. Alyward, J. L. Garnett, J. W. Hayes, and S. W. Law (Univ. of New South Wales, Sydney). J. Inorg. & Nuclear Chem., 16: 350-5(Feb. 1961). (In English)

A method of analysis in which metal ions are titrated radiometrically with tritium-labelled organic analytical reagents was developed, using the copper–anthranilic acid system as an example. Amperometric titrations were carried out to establish optimum conditions for the precipitation titration. Radiometric and amperometric end-points were found to be identical and reproducible. A technique is suggested for the routine analysis of metal ions, with tritium-labelled organic reagents. (auth)

15575 MODERN ANALYTICAL DETERMINATION OF ISOTOPES. (A Literature Review). Ádám Kovách. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrece Közlemények, 2: 217-24(1960). (In Hungarian)

In view of the recently initiated meteorite research project at the Atomic Research Institute of Debrecen involvin mass-spectrographic studies, the pertinent literature of the last decade has been reviewed. The work in Germany is under the direction of Prof. Paneth at the Max Planck Institute in Mainz; the Russian work is coordinated by the Meteorite Committee of the Academy of Sciences, most of the work being executed at the I. V. Vernadskiĭ Geochemical Research Institute under the supervision of Prof. A. P Vinogradov while in the United States the research is concentrated at the Brookhaven National Laboratory and the University of Minnesota. In addition to the systematic studies from these institutions, there are many publications from laboratories scattered all over the world. Only a few elements have been thoroughly investigated because there is no universally acceptable working hypothesis concernin the cause of the isotopic shift, except the effect of cosmic rays. Geological age determination work is centered on th long half-life nuclei and their daughters. Helium is the most investigated element; the formation of its isotopes is attributed to the effect of primary cosmic radiation. Amo the other isotopes found in meteorites are: tritium, Ne^{20}, Ne^{21}, and Ne^{22} A^{36}, A^{38}, and A^{39}; light radioactive nuclei such as Al^{26}, Be^{10} and Co^{60}, the K isotopes, Ca^{46}, and Sc^{45}. For age determination, U, Os, and Pb were studied. Data are available also on O, C, S, and Fe. (41 references.) (TTT)

15576 PAN COLORIMETRIC METHOD FOR THE MEASUREMENT OF MICRO QUANTITIES OF URANIUM IN ORGANIC AND INORGANIC MATERIALS. V. Camera (C.N.R.N., Ispra, Italy). Med. lavoro, 52: No. 1, 59-69 (1961). (In Italian)

A simple, sensitive, and accurate method is described for the colorimetric determination of uranium in urine, and, more generally, in various organic and inorganic materials. The method is based on the ability of 1-(2-pyridylazo)-2-naphthol (PAN) to give a colored complex with uranium at pH 9 in the presence of EDTA. Should there be a high level of impurities the method involves an initial extraction of uranium (in the form of uranyl nitrate by means of tributylphosphate (TBP). The sensitivity of the method is high (2 γ of uranium); the precision is remarkable, even in the case where preliminary extraction by means of TBP is necessary. In order to increase the sensitivity of the method (as a function of the pH) many complementary investigations and check analyses were carried out. Similarly the interference of different metallic ions, the specificity of the colored reaction, and the competition between EDTA and PAN in complexing uranium were investigated. A detailed description is given of the technique for estimating in urine samples and in air samples. (auth)

15577 RADIOACTIVATION ANALYSIS OF OXYGEN IN SILICON BY IRRADIATION WITH α-PARTICLES IN A CYCLOTRON. T. Nozaki, S. Tanaka, M. Furukawa, and K. Saito (Tokyo Univ.). Nature, 190: 39-40(Apr. 1, 1961).

The $O^{16}(\alpha,pn)F^{18}$ reaction was used in determining O_2 in amounts as low as 0.3 ppm in transistor-grade silicon irradiated with 40-Mev α particles in a cyclotron. The oxygen content was calculated from the disintegration rate of F^{18} by the absolute method. Procedures and equipment are described. (C.H.)

15578 THE ANALYSIS OF BERYLLIUM AND BERYLLIUM OXIDE. [PART] V. THE DETERMINATION OF CADMIUM. J. O. Hibbits (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati), Silve Kallmann,

Oberthin, and J. Oberthin. Talanta, 8: 104-8(Feb.-Mar. 61). (In English)

A method is described for the determination of cadmium beryllium or beryllium oxide. Cadmium is precipitated th benzotriazole using nickel as a carrier. A further paration from other elements is made by passing a chlode solution through Dowex-1 anion-exchange resin. The dmium is finally determined with dithizone. The method accurate to ±5% or 0.4 μg of cadmium, whichever is eater. No interference is caused by the presence of 10g amounts of 68 elements. (auth)

15579 THE DETERMINATION OF TRACES OF OSMIUM AND IRIDIUM IN SAMPLES OF PALLADIUM AND PLATINUM BY NEUTRON-ACTIVATION ANALYSIS. F. C. Morris and R. A. Killick (Brunel Coll. of Tech., London). Talanta, 8: 129-37(Feb.-Mar. 1961). (In English)

A method is described for the determination of ultramicro quantities of osmium and iridium in samples of palladium and platinum. In order to avoid self-shielding differences between samples and standards during neutron irradiation, standards are prepared by the addition of very small known amounts of osmium and iridium to analytical samples. In the analysis of palladium samples the Harwell Pile BEPO is used as the neutron source. To avoid spurious results due (n,p) and (n,α) reactions, the Pile DIDO has had to be used for neutron-activation of samples of platinum. Each determination requires 0.1 g of sample, and radiochemical separations using carriers are used to isolate the induced osmium and iridium activities. Results are quoted for the osmium and iridium contents of some pure palladium and platinum samples. (auth)

15580 ETHANOL–WATER–HYDROCHLORIC ACID ELUENTS IN ANION-EXCHANGE SEPARATIONS. D. H. Wilkins and G. E. Smith (General Electric Research Lab., Schenectady, N. Y.). Talanta, 8: 138-42(Feb.-Mar. 1961). (In English)

A ternary system of ethanol-water hydrochloric acid is investigated for the anion-exchange separation of elements which have low adsorption coefficients in aqueous hydrochloric acid solutions. A ternary system is used to express the data from batch distribution coefficients in order to facilitate the prediction of column separation. The anion-exchange separation of manganese from nickel and calcium and the separation of yttrium and scandium is accomplished. (auth)

15581 THE SEPARATION OF SUB-MICROGRAM AMOUNTS OF URANIUM FROM MILLIGRAM AMOUNTS OF IRON, ALUMINUM AND PLUTONIUM. D. G. Boase and J. K. Foreman (United Kingdom Atomic Energy Authority, Calderbridge, Cumb, Eng.). Talanta, 8: 187-90 (Apr. 1961). (In English)

A separation procedure was developed to facilitate the fluorimetric determination of sub-microgram quantities of uranium in the presence of milligram amounts of iron, aluminum, and plutonium. The sample is mixed with a strong hydrochloric acid solution containing hydriodic acid and passed through a column of anion-exchange resin. Only the uranium is retained on the resin and it can subsequently be eluted with dilute hydrochloric acid. (auth)

15582 THE ANALYSIS OF BERYLLIUM AND BERYLLIUM OXIDE. VI. THE DETERMINATION OF TANTALUM AND NIOBIUM. James O. Hibbits (General Electric Co., Cincinnati), H. Oberthin, R. Liu, and Silve Kallmann. Talanta, 8: 209-13(Apr. 1961). (In English)

A method is described for the determination of tantalum and niobium in beryllium or beryllium oxide. These two elements are precipitated with cupferron, using zirconium as a collector. A further separation from other elements is obtained by passing a mixed chloride–fluoride solution through a column containing a strongly basic anion-exchange resin. Niobium and tantalum are selectively eluted from the column and finally determined spectrophotometrically, niobium with hydroquinone and tantalum with pyrogallol. For niobium, the method is accurate to ±5% or 10μg, whichever is greater, and for tantalum it is accurate to ±10% or 30μg, whichever is greater. No interference was caused by the presence of 10-mg amounts of 68 elements. (auth)

15583 ISOTOPIC DILUTION ANALYSIS BY SOLVENT EXTRACTION. I. PRINCIPLE AND THEORY OF THE METHOD. Jaromír Růžikča and Jiří Starý (Faculty of Technical and Nuclear Physics, Prague). Talanta, 8: 228-34(Apr. 1961). (In English)

The proposed method serves for the selective determination of trace amounts of metals. The analytical procedure consists of a single extraction of the metal to be determined, in the form of a complex with an organic reagent, and measuring the radioactivity of the extract obtained. The amount of the organic reagent employed must always be less than would correspond to the stoichiometric ratio. A theoretical evaluation of the extraction is given for these conditions, from which the conclusion may be drawn that a number of metals may thus be determined with greater selectivity than in a conventional extraction with a stoichiometric excess of organic reagent. On the basis of the relation obtained, conditions were predicted for the determination of many elements. The possibilities of the selective determination of metals in the presence of interfering metals are also discussed. (auth)

15584 INVESTIGATION OF MACROQUANTITIES OF ZIRCONIUM IN AQUEOUS NITRIC ACID SOLUTIONS. V. M. Kolikov. Zhur. Priklad. Khim., 34: 248-58(Feb. 1961). (In Russian)

An analysis was made of the state of zirconium in nitric acid solutions with 0.1 to 0.5 mole/l ZrO and large quantities of saltpeter. The molecular weight of zirconium polymers was determined by the diffusion method, and the composition of zirconium complexes was determined by the distribution method and by an optical method. (R.V.J.)

15585 DETERMINATION OF SMALL AMOUNTS OF DEUTERIUM IN HYDROGEN. G. Nief (to Commissariat a l'Energie Atomique). Belgian Patent 570,106. Priority date, Sept. 26, 1957. (In French)

A mass spectrometer is used to separate H_2^+ ions from HD^+ and H_3^+ ions. If p is the pressure inside the ionization chamber, c the concentration of D_2, i_2 and i_3 the intensities due to H_2^+ and $HD^+ - H_3^+$ ions, respectively, the following equations can be written: $i_2 = Ap$, $i_3 = Bcp + Dp^2$, and $i_3/i_2 = (B/A)\,c + (D\,p/A) = (B/A)\,c + (D/A^2)\,i_2$, A, B, and D being constant. By means of thermocouples, an emf proportional to i_2^2 is produced; e_2 and e_3, proportional to i_2 and i_3, are generated by means of d-c amplifiers. Then: $e_2 = ai_2 = aAp$, $e_3 = bi_3 = bBcp + bDp^2 = bBcp + (bD/A^2)\,i_2^2$, a and b being constant. Creating $e_1 = (bD/A^2)\,i_2^2$, one obtains the equation, proportional to c, $(e_3 - e_1/e_2) = (bB/aA)c$, giving the concentration of D_2 with only one reading. (EURATOM)

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15586 (AERE-BIB-130) OXIDES OF EUROPIUM, GADOLINIUM, PRASEODYMIUM. AND SAMARIUM. A Bibliography. P. J. Jones, comp. (United Kingdom Atomic

Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Dec. 1960. 28p.

A bibliography is presented, consisting of 190 references to papers, patents, published literature, and reports, pertaining to the oxides of europium, gadolinium, praseodymium, and samarium. The references were obtained from Library catalogs at AERE, Harwell, and issues of Chemical Abstracts and Nuclear Science Abstracts published through 1958 and April 1960, respectively. The references are in alphabetical order of first author. Author and subject indexes are included. (B.O.G.)

15587 (OOR-2367:1) KINETICS AND EQUILIBRIA OF FORMATION OF STABILIZED CARBANIONS. Final Report, September 21, 1959—September 21, 1960. H. Shechter, M. J. Collis, M. Fukuyama, and S. S. Rawalay (Ohio State Univ. Research Foundation, Columbus). Feb. 15, 1961. Contract DA-33-019-ORD-3218. 11p.

The results of a study of the kinetics and equilibria of formation of stabilized carbanions are presented. Included are studies of effects of ring size on the rates of enolization of phenyl cycloalkyl ketones and cycloalkanones and kinetics of neutralization and ionization constants of meta- and para-substituted 1-phenylnitroethanes and nitrocycloalkanes; oxidation of primary, secondary, and tertiary amines. (auth)

15588 (TID-6989) CHEMICAL EQUILIBRIA AT HIGH TEMPERATURES AND THE MECHANISM OF VAPORIZATION OF COMPOUNDS. Ralph L. Seifert (Indiana. Univ., Bloomington). Oct. 25, 1960. 7p. Contract AT(11-1)-505.

Two types of experiments are involved. The first is an extension of the Knudsen effusion technique to the determination of the partial pressures of oxygen and other substances that are gaseous at room temperature. The second is a study of the vaporization mechanism by an application of Searcy's effusion oven technique to Langmuir type vaporization data. (W.L.H.)

15589 (TID-11056) FACTORS AFFECTING THE MECHANISM OF GRAPHITIZATION, THE HETEROGENEOUS GAS REACTIONS OF GRAPHITE, AND THE RELEASE OF CHEMISORBED GASES ON GRAPHITE BY THERMAL AND CHEMICAL TREATMENT. Progress Report for April 1, 1960 to March 31, 1961. P. L. Walker, Jr., C. R. Kinney, and H. B. Palmer (Pennsylvania State Univ., University Park. Coll. of Mineral Industries). Nov. 15, 1960. 25p. Contract No. AT(30-1)-1710.

The kinetics of carbon production from carbon suboxide (C_3O_2) is being investigated. Work is reported on the kinetics and mechanisms of gas-carbon reactions on highly homogeneous carbon surfaces. An investigation of the catalytic effect of iron on the carbon-carbon dioxide reaction is reported. A study is presented of the properties and reactivities of evaporated carbon films. (W.L.H.)

15590 (CEA-tr-R-1069) SUR L'INTERACTION DANS UN TRIPLE SYSTEME RECIPROQUE DE DEPLACEMENT $Tl_2Cl_2 + Zn \rightleftharpoons ZnCl_2 + 2\ Tl$. (Interaction in a Triple Reciprocal Displacement System $Tl_2Cl_2 + Zn \rightleftharpoons ZnCl_2 + 2\ Tl$). A. P. Palkin and I. P. Palyuza. Translated into French from Zhur. Neorg. Khim., 5: 160-71(1960). 33p.

The thermal analysis method was used to study the triple reciprocal displacement system $Tl_2Cl_2 + Zn \rightleftharpoons ZnCl_2 + 2Tl$. It was proven that this is a reversible system with a direct reaction and the inverse reaction progresses according to the equations: $2\ Tl_2Cl_2 + Zn \rightleftharpoons 2\ TlCl \cdot ZnCl_2 + 2\ Tl$ and $2\ ZnCl_2 + 2\ Tl \rightleftharpoons 2\ TlCl \cdot ZnCl_2 + Zn$; or in its entirety, $Tl_2Cl_2 + ZnCl_2 \rightleftharpoons 2\ TlCl \cdot ZnCl_2$. Consequently, the principle of the chemical interaction in the system is reduced to the formation of $2\ TlCl \cdot ZnCl_2$, which is the limit toward which the direct and inverse reactions progress. The excess of the initial components over the stoichiometric quantities does not enter the reaction. A triangulation along the compound $2\ TlCl \cdot ZnCl_2$ determines three stable triangles. The results of the examination of $Tl_2Cl_2 + Zn \rightleftharpoons ZnCl_2 + Tl$ are generalized in a spatial diagram. The system TlCl – T is characterized by an almost complete reciprocal nonsolubility of the components in the liquid state. The possibility of obtaining metallic thallium and zinc exists. (tr-auth)

15591 THERMAL EXPANSION OF AMMONIUM BROMIDE, RUBIDIUM BROMIDE AND RUBIDIUM CHLORIDE. V. T. Deshpande and D. B. Sirdeshmukh (Osmania Univ., Hyderabad, India). Acta Cryst., 14: 353-5(Apr. 10, 1961). (In English)

The lattice constants of ammonium bromide, rubidium bromide, and rubidium chloride were determined accurately at different temperatures, using a back-reflection camera, and the coefficients of thermal expansion were evaluated. The lattice constants of the three compounds at 20°C are 4.0587, 6.8908, and 6.5898 A, respectively. The coefficients of expansion of ammonium bromide and rubidium bromide vary parabolically with temperature according to the equations, $\alpha = 58.96 \times 10^{-6} - 11.98 \times 10^{-8}T + 35.00 \times 10^{-10}T^2$ and $\alpha = 38.00 \times 10^{-6} - 1.54 \times 10^{-8}T + 4.13 \times 10^{-10}T^2$, respectively. The lattice constant of rubidium chloride increases linearly with temperature and the mean coefficient of expansion for the range of temperature 20 to 190°C is 38.13×10^{-6}/°C. (auth)

15592 CHEMICAL PROPERTIES IN THE MOLTEN LiCl—KCl EUTECTIC. Guy Delarue (Ecole Superieure de Physique et de Chimie, Paris). Bull. soc. chim. France, p.906-10(1960). (CEA-1768). (In French)

A qualitative study was made of the behavior of S, sulfides, sulfites, and sulfates in the molten LiCl—KCl eutectic and also of a certain number of oxidation-reduction reactions which make it possible to pass from one of these compounds to another. (auth)

15593 CHEMICAL REACTIONS INVOLVING THE IONS O^{2-} AND S^{2-} IN THE MOLTEN LiCl—KCl SPEED EUTECTIC. Guy Delarue (École Supérieure de Physique et de Chimie, Paris). Bull. soc. chim. France, p.1654-9 (1960). (CEA-1769). (In French)

The variations of oxidation-reduction properties with O^{2-} and S^{2-} concentration in the melt make is possible to predict a certain number of chemical reactions. It is possible to justify the dissolution of slightly soluble oxides and sulfides, among others, by the action of oxidizing agents such as Cu^{2+}, Fe^{3+}, Au^{+}, and Cl_2. It is also shown that some reactions leading to the formation of complexes of O^{2-} with SO_3, and H^{+} occur. (auth)

15594 CONDITIONS FOR THE PREPARATION OF EUROPIUM PROTOXIDE. Jean-Claude Achard. Bull. soc. chim. France, No. 1, 31-3(Jan. 1961). (In French)

Europium monoxide is prepared by reaction of the sesquioxide with C. The present work describes the intermediate stages in the reduction of the sesquioxide and defines the formation conditions of the monoxide. The installation used is desoribed in some detail. In the first studies, made at high temperatures at reduced pressures in an inert atmosphere, an attempt was made to prepare the monoxide by the direct decomposition of the sesquioxide. No EuO could be detected. Rapid heating of the sesquioxide in the presence of carbon caused the distillation of the Eu_2O_3. Progressive heating of Eu_2O_3 in the

resence of carbon in an inert atmosphere at approximately tmospheric pressure yields EuO. (J.S.R.)

15595 THE SULFIDES OF YTTERBIUM. J. Flahaut, . Domange, M. Guittard, and J. Loriers (Faculté de harmacie, Paris). Bull. soc. chim. France, No. 1, 102-5 Jan. 1961). (In French)

Four phases were characterized in the sulfur–ytterbium ystem: the oxysulfide Yb_2O_2S of Ce_2O_2S type, the sulfide Yb_2S_3 with hexagonal crystals, the sulfide Yb_3S_4 found in a vide range of composition from $YbS_{1.46}$ to $YbS_{1.33}$, and the hase type NaCl observed only for the compositions $YbS_{1.15}$ o $YbS_{1.11}$. The structures of these phases are discussed vith respect to the crystallographic, densimetric, and magnetic measurements. (tr-auth)

15596 COMBINATIONS FORMED BY THE SULFIDES OF THE ELEMENTS OF THE RARE EARTH GROUP. II. THE EQUILIBRIUM DIAGRAM OF THE SYSTEM YTTRIUM SULFIDE–CALCIUM SULFIDE. Jean Flahaut, Louis Domange, and Madeleine Patrie (Faculté de Pharmacie, Paris). Bull. soc. chim. France, No. 1, 105-8(Jan. 1961). (In French)

Phase diagrams were studied crystallographically on tempered products. Two regions of homogeneity were characterized. The first, a cubic phase of the Th_3P_4 type, is stable only at high temperature and has a eutectoid point at t = 980°C for the composition Y_2S_3–0.47 CaS. The second phase is cubic of the NaCl type near the calcium sulfide. Two varieties correspond to the formula CaY_2S_3, one of which is orthorhombic of the Yb_3S_4 type and is stable up to 1110°C. The fusion curve was constructed for the compositions richer in Y_2S_3. (tr-auth)

15597 PROPERTIES OF SOME SOLID SOLUTIONS AND COMPOUNDS WITH LANTHANUM OXIDE BASE. M. Foex (C.N.R.S., Montlouis, Pyrénées-Orientales, France). Bull. soc. chim. France, No. 1, 109-17(Jan. 1961). (In French)

Certain aspects of the hydration mechanism of pure lanthanum oxide or of products mixed with lanthanum oxide are examined. This oxide is capable of dissolving, in the solid state, large quantities of some foreign oxides, such as SrO, BaO, and CeO_2. The properties of lanthanum oxide are strongly modified by these additions, both the electrical properties and the hydration velocities, which, very high for the pure oxide, can be decreased several hundred times in some cases. The effect of thermal and mechanical treatments on the properties of the preceding products is considerable. The last part of the work is devoted to the study of some combinations of lanthanum oxide with various basic oxides (NiO, CuO, Li_2O, and BeO) and the examination of some of the properties of the compounds formed. (tr-auth)

15598 CHROMATOGRAPHY IN HYDROCHLORIC SOLUTION OF TETRAVALENT PROTACTINIUM ON ANION EXCHANGE RESINS. Elisabeth Pluchet and Roland Muxart (Institut du Radium, [Paris]). Bull. soc. chim. France, No. 2, 372-3(Feb. 1961). (In French)

The behavior of tetravalent protactinium on anion exchange resins has been compared to that of Pa^{5+}, Th^{4+}, and U^{4+}. Pa^{4+}, just as Th^{4+}, is almost completely unretained in even concentrated hydrochloric acid on the anion resins Dowex-1 and Amberlite IR-401. Pa^{5+}, on the contrary, is strongly adsorbed, as is U^{4+}, in a sufficiently acid medium (6 N HCl or more). (tr-auth)

15599 ELECTRODE POTENTIALS OF THE URANIUM CHLORIDES IN FUSED ALKALI CHLORIDE SOLUTIONS. S. N. Flengas (Dept. of Mines and Technical Surveys, Ottawa). Can. J. Chem., 39: 773-84(Apr. 1961)..

Using a silver–silver chloride reference electrode, the electrode potentials of the system U, UCl_3(KCl, NaCl) and the redox potentials of the system Pt, UCl_3, UCl_4(KCl, NaCl) were measured at various concentrations of the uranium chlorides and at temperatures between 650 and 850°C. From the results, the electrode potential of the system U, UCl_4(KCl, NaCl) was calculated. In addition, the activity coefficients and partial molal properties of dilute solutions of UCl_3 and UCl_4 in the equimolar mixture of potassium and sodium chlorides were calculated. (auth)

15600 EVIDENCE OF THE CHEMICAL NATURE OF URANIUM SELENIDES. Parviz Khodadad (Faculté de Pharmacie, Paris). Compt. rend., 252: 1029-30(Feb. 13, 1961). (In French)

The reaction of uranium polyselenide USe_3 and the three allotropic varieties of the selenide USe_2 with an aqueous solution of silver nitrate was studied. The reactions of USe_2 can be written as $3\ USe_2 + 12\ AgNO_3 + 2\ H_2O \rightarrow 6\ Ag_2Se + 3\ UO_2(NO_3)_2 + 2\ NO + 4\ HNO_3$. Those of USe_3 can be written as $3\ USe_3 + 12\ AgNO_3 + 2\ H_2O \rightarrow 6\ Ag_2Se + 3\ UO_2(NO_3)_2 + 2\ NO + 3\ Se + 4\ HNO_3$. The reactions show that the compounds are ionic with respect to the U-Se bonds. Moreover, the particular case of USe_3, where one atom of selenium out of three does not participate in the double decomposition reaction, reveals the existence of covalence bonding. Because of the tendency of selenium to chain arrangement and the degree of oxidation of uranium, it is thought that covalent bonding is established between one selenium atom and the selenium atoms surrounding it. The latter selenium atoms are then connected to the tetravalent uranium ions of the lattice by electrostatic attraction. (J.S.R.)

15601 THERMODYNAMIC PROPERTIES OF NIOBIUM OXIDES (EQUILIBRIUM WITH CARBON AND ELECTROCHEMICAL MEASUREMENTS). V. I. Lavrent'ev, Ya. I. Gerasimov, and T. N. Rezukhina. Doklady Akad. Nauk S.S.S.R., 136: 1372-5(Feb. 21, 1961). (In Russian)

Specimens of niobium pentoxide (99.9% Nb_2O_5) and metallic niobium (98.6% Nb) were used in experiments on equilibrium reduction and electromotive force. Equilibrium in hydrogen reduction at 1200 to 1500°C was studied by a circulation method. Two stages of Nb_2O_5 reduction: $2.5\ NbO_{2.4} + H_2 \rightarrow 2.5\ NbO_2 + H_2O$ and $NbO_2 + H_2 \rightarrow NbO + H_2O$ were investigated. The logarithmic polytherms of the equilibrium constant show for the first stage (with an accuracy of ±0.2%) $\lg K_{p_I} = 15050/4.575T + 1.3306$ (1480 to 1673°K) and for the second stage (with an accuracy of ±0.3%) $\lg K_{p_{II}} = 29490/4.575T + 1.3304$ (1673 to 1823°K). The results of the electromotive force experiments proved to be in good agreement with published data. (R.V.J.)

15602 REDOXY POTENTIAL OF THE Ti^{2+}/Ti^{3+} SYSTEM AND THE EQUILIBRIUM CONSTANT OF REACTION $2T^{3+} + T \rightleftharpoons 3Ti^{2+}$ IN CHLORIDE MELTS. M. V. Smirnov, L. A. Tsiovkina, N. A. Loginov (Inst. of Electrochemistry, Urals Branch, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 136: 1388-91(Feb. 21, 1961). (In Russian)

Titanium trichloride was potentiometrically titrated in equimolar mixtures of fused sodium and potassium chlorides at 700°C. The indicator potential of a molybdenum electrode was measured directly in relation to a chloride electrode. Typical curves do not exhibit a characteristic potentiometric titration course of $E = E^0_{Ti^{2+}/Ti^3} + (RT/F) \ln [Ti^{3+}]/[Ti^{2+}]$. Their tendency is toward the reduction-oxidation potential value, found at about 0.5 closer to the positive titanium equilibrium potential. Hydrogen was replaced by metallic titanium in potentiometric titration measurements. The potentiometric curves (potential-reduction rate) depend on temperature, concentration, mix-

ture, and especially the surface increase of metallic titanium. The formal reduction-oxidation potential of Ti^{2+}/Ti^{3+} retains its constant value equal, within order of error, to $E^0_{Ti^{2+}/Ti^{3+}} = -1.726 \pm 0.005$. Titanium concentration did not exhibit any influence over the magnitude of the formal reduction-oxidation potential. (R.V.J.)

15603 SIMPLE PREPARATION OF Pu(IV) IN DILUTED $HClO_4$. E. Nebel and D. Nebel (Zentralinstitut fur Kernphysik, Rossendorf, Ger.). Kernenergie, 4: 15-18(Jan. 1961). (In German)

For equilibrium studies of Pu(IV) in aqueous solution the Pu(IV) should be, as far as possible, in the presence of other valences and excess foreign ion. A given acidity is necessary to prevent the hydrolysis of the Pu(IV). Electrolysis in 1 and 0.5 M $HClO_4$ at controlled potential was found to be a convenient method for the preparation of pure Pu(IV). The total Pu is first converted electrolytically into Pu(III). It is now necessary to exchange the Pt spiral being used as cathode before the resulting oxidation or to treat it at short intervals with chromosulfuric acid. An improved potential standardization is thereby obtained. As the potentials for Pu(III)/Pu(VI) and Pu(IV)/Pu(VI) appear slowly, the Pu(III) can be oxidized carefully to Pu(IV) without further oxidation to Pu(VI) occurring. (J.S.R.)

15604 SPECTROPHOTOMETRIC STUDIES OF ELECTROLYTIC DISSOCIATION. PART 6. URANYL CHLORIDE IN 50% ETHANOL AND URANYL SULPHATE IN 20% METHANOL. D. E. B. Morgans and C. B. Monk (University Coll., Aberystwyth, Wales). Trans. Faraday Soc., 57: 463-7(Mar. 1961).

The thermodynamic dissociation constant of UO_2Cl^+ in 50% ethanol at 25°C, from several sets of measurements, is assessed as 0.057 ± 4%, and the ion-size parameter as 4.5 ± 0.2 Å. Similarly, 10^5K_1 for $UO_2SO_4 = 13.2 \pm 6\%$ in 20% methanol and K_2 for $UO_2(SO_4)_2^{2-} \simeq 0.02$. (auth)

15605 TECHNETIUM — THE FORTY-THIRD ELEMENT. A. N. Murin, V. D. Nefedov, Yu. A. Ryukhin, and M. A. Torpova. Uspekhi Khim., 30: 274-91(Feb. 1961). (In Russian)

The discovery of technetium and the preparation of 19 isotopes and isomers are reviewed. The effects of electron density, pressure, and temperature on Tc^{99} decay are analyzed. The origin and presence of technetium isotopes in nature are discussed. A table is included showing prepared technetium isotopes, their electron configurations, and their valence states. The properties of elementary technetium and compounds with valence states from 7^+ to 1^- are discussed. A method for separating technetium is given. 85 references. (R.V.J.)

15606 THE CHEMISTRY OF ACTINIDE AND RARE EARTH SULFIDES. G. V. Samsonov and S. V. Radzikovskaya (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Uspekhi Khim., 30: 60-91 (Jan. 1961). (In Russian)

A detailed review is given on the preparation, structure, properties, and industrial applications of sulfides and oxysulfides of scandium, yttrium, the lanthanides, and the actinides. 78 references. (R.V.J.)

Radiation Chemistry and Radiochemistry

15607 (AN-218) HYDRAZINE PROGRAM. Quarterly Progress Report No. 1, April through June 1960. (Aerojet-General Nucleonics, San Ramon, Calif.). Contract AF33 (600)-40878. 107p.

A progress report is presented on the program for studying the feasibility of direct in-reactor production of hydrazine from liquid ammonia. Chemical and energy deposition analytical procedures have been selected, and in-reactor equipment and control instrumentation have been designed. The purposes and long-range goals of the program, hazards, and handling procedures for hydrazine are discussed, and a literature search for information on radioinduced formation of hydrazine is included. (D.L.C.)

15608 (AN-252) HYDRAZINE PROGRAM. Quarterly Progress Report No. 2 [for Period] July through September 1960. (Aerojet-General Nucleonics, San Ramon, Calif.). Contract AF 33(600)-40878. 140p.

Measurable quantities of hydrazine were produced in relatively crude experiments conducted in a low flux reactor environment. Measured G values (subject to considerable uncertainty) ranged from 1.0 to 1.9 molecules hydrazine per 100 ev energy deposited in ammonia; this yield is well within the range of economic interest. Preparations are essentially complete for high flux runs scheduled to start in the Livermore Pool Type Reactor (LPTR) in November. These preparations include the design, fabrication, assembly, and testing of the experimental equipment; preparation and publication of a Safeguards Report; and the development and testing of chemical and energy deposition analytical techniques. The high flux runs will determine hydrazine, hydrogen, and nitrogen G values with the precision and reliability required for more accurate economic evaluation of the process. Additional studies will be conducted in the fuel solubility field. If a compound of appropriate solubility is found, LPTR runs incorporating the compound as a fuel will be planned. Preliminary future phase planning was started under the assumption that yields of economic interest will be attained in the LPTR. (auth)

15609 (AN-299) HYDRAZINE PROGRAM. Quarterly Progress Report No. 3 [for Period] October through December 1960. (Aerojet-General Nucleonics, San Ramon, Calif.). Contract AF 33(600)-40878. 78p.

Four high-flux hydrazine production experiments were conducted in the Livermore Pool Type Reactor. All of these experiments produced measurable quantities of hydrazine; the most recent run showed a G-value of 1.7 molecules of hydrazine per 100 ev energy deposited. This yield was roughly twice that presently considered necessary for economic feasibility. Prior to the start of LPTR experimentation, the fabrication, assembly, and testing of experimental equipment was completed. Final development and testing of chemical and energy deposition analytical techniques were accomplished. Two calibration irradiations were made in the LPTR to allow determination of fissions in the subsequent hydrazine production runs. Additional fuel solubility experiments demonstrated that markedly increased solubility of UO_2 and UCl_4 in ammonia can be brought about by the co-solution of NH_4Cl. Future hydrazine production experiments will be designed to demonstrate the effects on yield of fuel concentration, flux, product concentration, and temperature. (auth)

15610 (BLG-54) ETUDE D'UNE CHAMBRE A IONISATION A HEXAFLUORURE D'URANIUM. (Ionization Chamber Studies on Uranium Hexafluoride). J. Schmets, G. Calleri, and R. Bellie (Brussels. Centre d'Etude de l'Énergie Nucléaire). Nov. 25, 1960. 28p.

The ionization produced by uranium hexafluoride α particles on itself in the gaseous state was measured. The corresponding calculations were made by two different methods and extended to mixtures of uranium hexafluoride and a diluting gas. Good agreement between digital com-

puter calculations and the experimental results was observed. Such measurements can be applied to the continuous detection and determination of uranium hexafluoride in industrial installations. (auth)

15611 (IEA-37) PRODUCTION OF CARRIER-FREE PHOSPHORUS-32 BY USING SULPHATES AS MATERIAL FOR IRRADIATION. F. W. Lima, A. Abrao, and L. T. Atalla (Sao Paulo, Brazil. Universidade. Instituto de Energia Atomica). 1960. 7p.

Presented at the Third Inter-American Symposium on the Peaceful Application of Nuclear Energy, Petropolis, Brazil, July 16-23, 1960.

A method of producing P^{32} by irradiating magnesium sulfate is described. Chemical operations, apparatus, yields, and advantages of the process are discussed. (J.R.D.)

15612 (MMPP-167-1) ENERGETIC RECOIL ATOM REACTION MECHANISMS. Progress Report No. 1, June 1, 1960–February 28, 1961. Adon A. Gordus (Michigan. Univ., Ann Arbor. Michigan Memorial Phoenix Project). Mar. 1961. Contract AT(11-1)-912. 81p. (ORA-2710-1-P).

Activities were concerned principally with investigations of the chemical effects of nuclear transformations. The theoretical work during the period was limited to research on primary activation processes. The experimental studies were aimed at examination of the initial activation processes as well as hot-atom reaction mechanisms. In theoretical work, a closed general solution of the probability distribution function for three-dimensional random-walk processes was derived. Two, three, and four random steps are described. In other theoretical work, calculations concerning the momentum-transfer required for bond rupture were developed which are valid for any case of a randomly directed impulse. In experimental work, the reaction of Br^{80} with gaseous methane was studied. Results indicate that this reaction occurs as a result of gamma-recoil kinetic energy. The mechanism of I^{128} reaction with CH_4 was also studied. The observed production of organically bound I^{128} for various methane-inert gas reaction systems is tabulated. The mixtures contain methane, inert gas, Methyl iodide, and iodine scavenger. Radioinduced reactions are discussed. (J.R.D.)

15613 (NAS-NS-3026) THE RADIOCHEMISTRY OF MERCURY. Josef Roesmer and Paul Kruger (Nuclear Science and Engineering Corp.). Dec. 1960. 55p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

A review on the radiochemistry of Hg is presented which includes the nuclear and chemical features of particular interest to the radiochemist. A discussion of sample dissolution aspects and counting techniques is also included. A collection of radiochemical procedures for the element is also included. (64 references). (J.R.D.)

15614 (NAS-NS-3027) THE RADIOCHEMISTRY OF COPPER. F. F. Dyer and G. W. Leddicotte (Oak Ridge National Lab.). [1961]. 59p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

A review on the radiochemistry of Cu is presented which includes the nuclear and chemical features of particular interest to the radiochemist. A discussion of sample dissolution aspects and counting techniques is also included along with a collection of radiochemical procedures for the element. (115 references). (J.R.D.)

15615 (NAS-NS-3028) THE RADIOCHEMISTRY OF RHENIUM. G. W. Leddicotte (Oak Ridge National Lab.). [1961]. 48p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

A review on the radiochemistry of Rh is presented which includes the nuclear and chemical features of particular interest to the radiochemist, and a discussion of problems of sample dissolution and counting techniques. A collection of radiochemical precedures for the element is also included. (J.R.D.)

15616 (NP-9962) EXPERIMENTS ON THE POSSIBILITY OF RAPID SEPARATION OF Mg FROM IRRADIATED Li–Mg ALLOY BY USE OF ION-EXCHANGE RESINS. Takanobu Ishida (Brookhaven National Lab., Upton, N. Y.). May 19, 1958. 95p.

Thesis submitted to New York Univ.

The possibility was investigated of using an ion-exchange column to separate radioactive Mg from neutron-irradiated Li–Mg alloy. Besides large quantities of Li and Mg and tracer quantities of Mg^{28}, the alloy contained tracer quantities of Na^{24}, Fe^{59}, and Cu^{64}. A remotely controlled method of separation was sought that would be completed in 2 hr or less. Results are summarized. It is shown that if the time is restricted to 2 hours, there is no suitable ion-exchange separation method. Equipment and results are described. It is also shown that the purification of Mg can be performed entirely by ion exchangers if the batch is divided into 5 portions and 5 identical operations are carried out for the removal of Cu. The purification takes about 6 hrs. (C.H.)

15617 (NYO-2529) A STUDY OF THE MECHANISM OF RADIATION INDUCED REACTIONS OF ORGANIC POLYMERS WITH INORGANIC SALTS AND ORGANOMETALLIC COMPOUNDS. Quarterly Summary Report January 1, 1961–March 31, 1961. (Radiation Applications Inc., Long Island City, N. Y.). Apr. 1, 1961. Contract AT(30-1)-2318. 13p.

Grafting of Styrene to Low Density Polyethylene: Effect of Film Thickness. The rate of grafting was examined as a function of polyethylene film thickness (3 and 5 mil), using both undiluted styrene and 70% methanol–30% styrene. The results show identical grafting rates for both films with either styrene or 70% methanol–30% styrene, indicating homogeneous grafts for both cases. Grafting of t-butylaminoethylmethacrylate to Low-Density Polyethylene. The experimental procedure was revised, and the grafting rate was studied in the presence of n-hexane as a function of irradiation time and % monomer. Grafting of Styrene to Polyvinyl Chloride. Control grafting experiments indicate that lower molecular weight fractions of grafted PVC become more soluble in benzene as grafting progresses. Grafting was therefore studied in the presence of methanol using high-molecular-weight PVC resin films to minimize leaching and side effects. The results show that methanol accelerates the grafting. Solubility Study of the System Styrene–Methanol–Nylon. Nylon samples were immersed in styrene–methanol solutions at 25°C, removed, and weighed to constant weight. The equilibrium-swollen samples were then wiped dry and irradiated to a total dose of 12.5 Mrad to polymerize the sorbed styrene. The data were used to calculate various grafting kinetic terms for this system. (D.L.C.)

15618 (TID-11112) BASIC STUDIES OF THE EFFECT OF ELECTROPHILIC ADDITIVES ON THE RADIOLYTIC PRODUCTS OF ORGANIC CHAIN REACTIONS. First Progress Report April–October 1960. (Little (Arthur D.) Inc., Cambridge, Mass.). Contract AT(30-1)-2551. 18p.

Factors governing the energy transfer between an adsorbent and an organic molecule, under the influence of ionizing radiation, were investigated. Several radiation runs were made on a mixture of two hydrocarbons, propylene and

isobutane, on pure silica gel and on ferric oxide treated silica gel. The radiation yields, as well as the spectrum of products, are presented. (W.L.H.)

15619 (TID-11116) THE EFFECT OF β-IRRADIATION PRIOR TO REACTION ON CATALYST ACTIVITY. Fourth Quarterly Progress Report. Nicholas J. Stevens (Massachusetts Inst. of Tech., Cambridge). November 1960. 17p. Contract AT(30-1)-2329.

Recent efforts in the study of β-irradiation prior to reaction were confined to the determination of the catalytic activity of CuO on Cu before and after several irradiations. A number of catalysts were prepared using a standard procedure, but only a limited amount of kinetic data was obtained on most of the catalysts. The most recent group of kinetic experiments was carried out on active catalysts at atmospheric pressure and at temperatures from 135 to 160°C. The reaction kinetics of CO oxidation on active CuO catalysts were determined in a constant volume reactor. The change in pressure occurring as a result of reaction was used to follow the course of the oxidation. (W.L.H.)

15620 (TID-12356) A STUDY OF THE FREE RADICAL YIELD PRODUCED IN 1-BROMOBUTANE BY IRRADIATION WITH MONOCHROMATIC X-RAYS OF DIFFERING PHOTON ENERGIES (thesis). Resonance in Radiation Report No. 4. William R. Clendinning (Michigan. Univ., Ann Arbor). 1960. Contract AT(11-1)-684. 213p.

A study was conducted to determine whether the radiation effect yield per unit of energy absorbed in certain chemical systems is a function of the photon energy of the radiation. Liquid 1-bromobutane was irradiated with monochromatic x rays. Results indicated that the free radical yield of this compound is independent of energy for the 16 K emission energies used. (513 references) (J.R.D.)

15621 (TID-12365) THE ENERGY DEPENDENCE OF X-RAY DAMAGE IN AN ORGANIC MERCURY COMPOUND (thesis). Resonance in Radiation Report No. 6. Marvin Cleveland Atkins (Michigan. Univ., Ann Arbor). 1960. Contract AT(11-1)-684. 154p.

An investigation was made into the extent to which the decomposition of an organic mercury compound by x rays depends on the photon energy of the x rays. Techniques for irradiating with monoenergetic x rays and for measuring the energy flux of the monoenergetic beam were developed. Measurements were made of the energy dependence of the liberation of free mercury from an organic mercury compound in the energy region of the L-absorption edges of mercury. The theory of the effects of ionizing radiation is discussed. Samples of α-acetoxymercuri-β-methoxy hydrocinnamic ethyl ester were irradiated with monochromatic x-ray beams at energies between 9 and 18 kev. It was previously determined that there is no dependence of the radiation yield on total dose or dose rate. It was found that within experimental error the radiation yield is independent of photon energy in the energy range studied. It was also found that the amount of mercury liberated per unit energy absorbed is the same, within experimental uncertainty, for soft x rays as for Co^{60} radiation. (M.C.G.)

15622 (WADD-TR-60-41) RADIOLYSIS OF ARALKYL KETONES. Weldon G. Brown and Donald J. Coyle (Chicago. Univ.). Aug. 1960. Contract AF33(616)-3875. 10p.

Products from the gamma irradiation of n-butyrophenone, isobutyrophenone, and benzoylcyclopropane were examined. Total yields of gaseous products decline markedly in the order named; G-values for total gas, at the lowest dose employed, namely, 6×10^{19} ev/g, were 3.8, 0.62, and 0.13, respectively. Parallel studies of the decomposition of the ketones by ultra-violet light were performed. The predominant reaction in both radiolysis and photolysis of n-butyrophenone is a splitting to produce ethylene and acetophenone. This is presumed to be a molecular excitation process of the Norrish-Bamford type. Isobutyrophenone gives rise to a variety of gaseous products, in both radiolysis and photolysis, believed to arise chiefly from a splitting to benzoyl and C_3 radicals. Benzoyl cyclopropane is remarkably resistant to radiolytic decomposition; photolysis studies were not completed. (auth)

15623 STUDIES ON THE CHEMICAL FORMS OF THE RECOIL PRODUCTS IN SOME NEUTRON-IRRADIATED PHOSPHORUS COMPOUNDS. Kenji Yoshihara and Tetsuyoshi Yokoshima (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 34: 123-30(Jan. 1961). (In English)

The chemical forms of the recoil products in neutron-irradiated phosphorus compounds were studied by paper chromatography. Fifteen tables show the Szilard-Chalmers effect enriches the chemical species and does not effect the target compounds. The enrichment of P^{32} was also examined by coloration. (N.W.R.)

15624 THE USE OF RADIOACTIVE FISSION PRODUCT RARE GASES FOR THE STUDY OF THE CHANGE IN CRYSTAL STRUCTURE. Seishi Yajima, Sumio Ichiba, Yuichiro Kamemoto, and Koreyuki Shiba (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 34: 133-6 (Jan. 1961). (In English)

The high-temperature x-ray diffraction method was used to confirm the correlation between fission gas release from hematite and the crystal structure change. The release of absorbed recoil Kr and Xe and continuous x-ray diffraction lines are shown as functions of temperature. The usefulness of the method in studies of physical chemistry is discussed. (N.W.R.)

15625 MECHANISM OF THE RECOIL PHENOMENA IN HEXAMMINECOBALT(III) CHLORIDE. Nagao Ikeda (Tokyo Univ. of Education), Kenji Yoshihara, and Shigeru Yamagishi. Bull. Chem. Soc. Japan, 34: 140-1(Jan. 1961). (In English)

The recoil effects in hexamminecobalt(III) chloride revealed that processes more complicated than replacement are involved. A small percentage of the activity produced in a target is found in the form of chloropentamminecobalt(III) chloride as the result of recoil, and its radiochemical yield decreases on standing even at room temperature. The rate-determining step in the process is not diffusion, but a chemical reaction. (N.W.R.)

15626 RADIATION-INDUCED EXCHANGE REACTIONS IN SOLUTIONS OF HYDROGEN IN WATER. P. J. Dyne, J. W. Fletcher, W. M. Jenkinson, and L. P. Roy (Atomic Energy of Canada Limited, Chalk River, Ont.). Can. J. Chem., 39: 933-9(Apr. 1961). (AECL-1200).

The exchange of H, D, and T atoms between water and dissolved hydrogen was studied in both heavy and light water solutions. Values of the "exchange yield", G_{tracer}, for the isotopic hydrogen atoms are deduced and are identified with the yield of D atoms from HDO in H_2O, H atoms from HDO in D_2O, T atoms from HTO in H_2O and from DTO in D_2O. These values are correlated by assuming that the medium, H_2O or D_2O, affects the total probability of dissociation of the tracer molecule (HDO, HTO, DTO) and that in HDO H atoms are more readily dissociated than D atoms. (auth)

15627 REDUCTION BY γ RAYS OF SULFURIC SOLUTIONS OF PERSULFATE. Jacques Pucheault, Christiane

Ferradini, and Antoinette Buu-Jacquemin (Laboratoire Curie, Paris). Compt. rend., 252: 1017-19(Feb. 13, 1961). (In French)

Under certain experimental conditions, sulfuric solutions of persulfate are reduced by γ radiation with the yield G = 2.7 equiv/100 ev. In this case no exchange of sulfur takes place between the ions HSO_4^- and $S_2O_8^-$. A reaction scheme is proposed. (tr-auth)

15628 THE USE OF IONIZING RADIATION IN STUDYING THE PROCESS INVOLVED IN THE DECOMPOSITION OF COPPER AND NICKEL OXALATES. V. A. Gordeeva, E. V. Egorov, G. M. Zhabrova, B. M. Kadenatsi, M. Ya. Kushnerev, and S. Z. Roginskii (Inst. of Physical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 136: 1364-7(Feb. 21, 1961). (In Russian)

Radioinduced topochemical disintegration processes in inorganic compounds were compared to ordinary thermal decomposition processes, using copper and nickel oxalates prepared by precipitation from 0.2N nitrate solutions with 0.4N oxalic acid at 50°C. The prepared $CuC_2O_4 \cdot {}^1/_2\ H_2O$ and $NiC_2O_4 \cdot 2H_2O$ were irradiated with 0.6 to 2-Mev fast electrons. Data on radiation and thermal decomposition products show that radiation decomposition at 100 to 150°C tends to metal formation according to the reaction (1)$MeC_2O_4 \rightarrow Me + 2CO_2$ for the nickel oxalate and according to (1)$MeC_2O_4 \rightarrow Me + 2CO_2$ and (2)$2MeC_2O_4 \rightarrow Me_2O + CO + 3CO_2$ for copper oxalate. Neither NiO nor CuO were observed. Due to the low temperature of radiation processes, the oxidation of decomposition products was low. Thermal decomposition of non-irradiated oxalates in vacuum begins at 225°C for copper and at 240°C for nickel, the disintegration in air begins at 250°C for copper oxalate and at 300°C for nickel oxalate, forming CuO and Cu_2O and NiO. The radiation studies combined with kinetic and x-ray diffraction analyses suggest an electron mechanism for the processes. (R.V.J.)

15629 ENERGY TRANSFER AND QUENCHING PROCESSES IN THE SYSTEM CYCLOHEXANE–BENZENE–TERPHENYL–OXYGEN. A. Weinreb (Argonne National Lab., Ill.). J. Chem. Phys., 34: 1316-19(Apr. 1961).

A quantitative explanation of the results of Berry and Burton is offered. Some additional results on the effect of oxygen on the fluorescence of terphenyl are included. (auth)

15630 IMPORTANCE OF THE NH_2 RADICAL IN THE DECOMPOSITION OF HYDROXYLAMINE BY IONIZING RADIATION IN AQUEOUS SOLUTIONS. M. Lefort and X. Tarrago (Faculte des Sciences, Paris). J. Inorg. & Nuclear Chem., 16: 169-86(Feb. 1961). (In French)

It was possible to determine exactly the stages of the oxidation-reduction mechanisms from hydroxylamine to ammonia (reduction of NH_2OH) and from hydroxylamine to nitrogen and various oxides (oxidation of NH_2OH) by deeper study of the effects of high-energy radiation on aqueous solutions. This study provides a means of elucidating the mechanism of certain chemical processes and of obtaining completely original information about the effect of the radical NH_2 on the dissociation of $NH_3^+ \rightleftharpoons NH_2 + H^+$. In addition the complete kinetics of the decomposition of hydroxylamine under radiation is calculated. (N.W.R.)

15631 HIGH SPECIFIC ACTIVITY $^{35}SO_2$ FROM NEUTRON IRRADIATED CCl_4. R. H. Herber (Rutgers Univ., New Brunswick, N. J.). J. Inorg. & Nuclear Chem., 16: 361-3(Feb. 1961). (In English)

By appropriate scavenger techniques $S^{35}O_2$ of high specific activity was recovered from neutron-irradiated carbon tetrachloride. The sample was irradiated to 2.9×10^{17} n/cm^2, and after 3 days of cooling, the $S^{35}O_2$ was scavenged by purified SO_2 and radioassayed by standard procedures leading to precipitation of $BaS^{35}O_4$ and counting. Calculations showed that well over 90% was recovered. (T.R.H.)

15632 THE CHEMICAL STABILITY OF TRIBUTYL PHOSPHATE IN SOME NITRATE AND CHLORIDE SYSTEMS. A. J. Moffat and R. D. Thompson (Phillips Petroleum Co., Idaho Falls, Idaho). J. Inorg. & Nuclear Chem., 16: 365-6(Feb. 1961). (In English)

Preliminary studies have disclosed two factors about the chemical stability of TBP which are very important to the processing of nuclear fuels. First, the so-called acid catalyzed hydrolysis of TBP (equilibrated with 2 to 5 M acid) is not primarily a hydrolysis reaction, but a dealkylation reaction. Second, TBP is degraded quite rapidly by (a) a homogeneous reaction with extracted zirconium (nitrate or chloride) and by (b) a heterogeneous reaction with solid zirconium compounds (nitrate or chloride). In both (a) and (b) either n-butyl nitrate or n-butyl chloride and insoluble zirconium organic phosphates are major products. (N.W.R.)

15633 THE PREPARATION OF CARRIER-FREE I^{131} FROM TELLURIUM DIOXIDE IRRADIATED IN THE POLISH REACTOR EWA. T. Zeleany and R. Plejewski (Inst. of Nuclear Research, Academy of Sciences, Warsaw). Kernenergie, 3: 1198-1201(Dec. 1960). (In German)

In a quartz flask tellurium dioxide of high purity was irradiated in the reactor. Then the flask is heated to a temperature of 680 to 700°C. The iodine sublimated was absorbed in a 0.01 N NaOH solution. The reading of the ionization chamber which is connected to the collector permits the optimum heating time to be established. The radiochemical and chemical purity and the specific activity of the final product corresponds to the requirements for medical preparations. The same carrier material can be reirradiated and the iodine collected. (tr-auth)

15634 PHOTOCHEMICALLY PRODUCED COLOR CENTERS IN KCl AND KBr. John A. Cape (Univ. of Illinois, Urbana). Phys. Rev., 122: 18-25(Apr. 1, 1961).

KCl and KBr crystals were exposed to unfiltered mercury arc radiation at 15°K. If an "OH" band was present in the crystals before irradiation, the ultraviolet irradiation produced an optical absorption spectrum similar to that produced by x-rays at 15°K. The optical absorption spectrum and the changes in the absorption produced by annealing at higher temperatures were measured and compared with the spectra observed during similar annealing of x-irradiated crystals. In KCl the 335-mμ band, formed by the uv irradiation, bleaches thermally at 56°K as does the 335-mμ H band of x-irradiated KCl. In KBr the 381-mμ band bleaches in steps at 35°, 46°, 56°, and 80°K as compared with the 381-mμ H band in x-irradiated KBr which bleached at 30°, 46°, 56°, and 80°K. In both KCl and KBr the V_1 band appears with the disappearance of the H band. Illumination in the V_1 band causes regeneration of the H band as occurs in x-irradiated KCl and KBr. In both KCl and KBr the photoproduced H band grows by about 10% at approximately 25°K. It is concluded that the H centers bleach thermally by diffusing to and combining with other color centers. Recombination with F and α centers annihilates the H centers and leads to the formation of V_K centers, while recombination with a third center (possibly a positive-ion vacancy) results in the formation of V_1 centers. U, U_1, U_2, O^-, and α centers are produced by the uv irradiation as well as F and H centers. The photoproduced F band may be bleached optically with negligible effect on the H band. (auth)

15635 ENERGY RELEASE IN REACTOR-IRRADIATED COPPER. [PART] II. 600° TO 700°K RELEASE. T. H. Blewitt (Oak Ridge National Lab., Tenn.). S. T. Sekula and J. Diehl. Phys. Rev., 122: 53-7(Apr. 1, 1961).

The energy release associated with the recovery peak occurring between 600 and 700°K in neutron-irradiated copper was measured utilizing a new technique, that of nuclear heating. Following a bombardment at 40°C of 1.7×10^{20} fast neutrons of a 1/E distribution which raised the critical shear stress to 12.8 kg/mm^2 at 4.2°K (5.2 kg/mm^2 at 300°K), a release of 7.7 cal/mole was measured. Using this measured value of the energy release it is possible to estimate the number of defects annihilated if it is assumed that the annealing is the result of the migration and subsequent annihilation of a single defect. In this way the number of interstitials, vacancies, interstitial-vacancy pairs, and dislocation lines required to account for the measured energy release were estimated. The values were, respectively, 5×10^{19} per mole, 2×10^{20} per mole, 4×10^{19} per mole, and 1×10^{12} cm per mole. (auth)

15636 THE OXIDATION OF TETRALIN INDUCED BY ^{60}Co γ-RADIATION. D. Verdin (Wantage Research Lab., Berks, Eng.). Trans. Faraday Soc., 57: 484-92(Mar. 1961).

The oxidation of tetralin initiated by Co^{60} γ rays was studied at dose rates up to 3.66×10^{18} ev l^{-1} sec^{-1}. The kinetics of oxygen absorption in the temperature range 25 to 70°C, are consistent with a hydroperoxy-chain mechanism having an overall activation energy of 7.7 kcal/mole. The radical yield from tetralin was G = 1.52 radicals per 100 ev of energy absorbed. Small amounts of H_2O_2 (G = 0.47) result from the initiation step, and a molecular yield of H_2 (G = 0.26) was observed. At 25°C, the O_2 absorbed is almost quantitatively converted to hydroperoxide and H_2O_2 in the initial stages of the reaction. More extensive oxidation results in decomposition of the hydroperoxide so that its concentration becomes less than the amount of O_2 absorbed. (auth)

15637 PREPARATION OF RADIOACTIVE IODINE-131. (to N. V. Philips' Gloeilampenfabrieken). Belgian Patent 571,045. Mar. 9, 1959. (In French)

I^{131} is prepared by irradiation of tellurium oxide powder with slow neutrons. The powder is then mixed with water, hydrogen peroxide, and concentrated sulfuric acid. I^{131} is recovered by distillation from this aqueous suspension. (EURATOM)

15638 SEPARATION OF PHOSPHORUS^{32}. (to Centre d'Etude de l'Energie Nucleaire). Belgian Patent 584,693. Priority date, Nov. 9, 1958. (In French)

P^{32} is produced by irradiation of S^{32} as a by-product of a (n,p) reaction. An organic solvent such as toluene with a density below that of water is used to dissolve the remaining S, and P is extracted from this solution, to which water is added, by heating. About 99% pure P^{32} is produced with a yield of 90%. (EURATOM)

15639 MANUFACTURE OF NEW GRAFT COPOLYMERS. Robert Roy Smith, Dennis Charles Macmillan Mann, and Enid Bevis (to B. X. Plastics Ltd.). British Patent 861,455. Feb. 22, 1961.

A method is given for producing graft copolymers derived from polyvinyl chloride (or a copolymer of vinyl chloride) and ethyl acrylate. In this method, polyvinyl chloride or vinyl chloride copolymer is subjected to ionizing radiation while in contact with ethyl acrylate monomer, whereby a block copolymer and a graft copolymer form in certain proportions. The extent of cross-linking can be varied according to the conditions employed. The irradiation should be carried out in the absence of oxygen, and the total dose should be within the range 10^4 to 10^6 rep. (D.L.C.)

15640 POLYMERIC MATERIAL. (to E. I. du Pont de Nemours and Co.). British Patent 861,948. Mar. 1, 1961.

A process is outlined for producing novel elastomer products by graft copolymerizing 2,3-dichloro-1,3-butadiene on polychloroprene. The graft copolymerization may be initiated either by a free-radical catalyst or by gamma irradiation, and the 2,3-dichloro-1,3-butadiene should constitute 8 to 70 wt.% of the elastomer. The elastomer products have lower solubility in boiling benzene, lower brittle points, and higher strength properties than those of ordinary random copolymers of the reactants. (D.L.C.)

15641 CHEMICAL COMPOUNDS. (to E. I. du Pont de Nemours and Co.). British Patent 861,951. Mar. 1, 1961.

A continuous process is outlined for producing elastomeric copolymers of vinylidene fluoride and hexafluoropropene. In this process, 30 to 70 wt.% vinylidene fluoride is mixed with hexafluoropropene, and the mixture is fed continuously in the form of an aqueous emulsion into a reaction vessel and reacted therein at constant temperature (55 to 120°C) and pressure (250 to 1500 psi) in the presence of a constant proportion of a polymerization initiator (0.001 to 2 wt.%). The elastomeric copolymers thus obtained may be treated further by a curing process using chemicals and/or ionizing radiation to give a product insoluble in organic solvents, resistant to acids, and stable above 400°F. (D.L.C.)

15642 IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF GRAFT COPOLYMERS. Robert Roy Smith (to B. X. Plastics, Ltd.). British Patent 863,211. Mar. 22, 1961.

A process for the radioinduced manufacture of graft copolymer from a polymer and a grafting monomer is given in which homopolymerization of the monomer is reduced or prevented by using the monomer in the vapor phase. A nonvolatile polymerization inhibitor can also be used for this purpose if dissolved in the liquid monomer forming the vapor phase. (D.L.C.)

15643 SOURCE OF PRODUCTS OF NUCLEAR FISSION. (to Rensselaer Polytechnic Inst.). British Patent 863,797. Mar. 29, 1961.

A source of fission products comprising a fibrous mineral (usually fibrous glass in the form of a wool) containing a fissionable or fertile material is described. The advantages of such a material are greater dimensional stability, higher efficiency (up to >60%) of utilization of fission fragment energy (as in fixing nitrogen), and easier separation of fission products from the glass fibers where their diameter is less than 10 μ. These advantages mean that a packed bed of the material can be used in a reactor core with He or CO_2 as coolant and that this material can be used to prepare fissionable material free from fission products. Seven examples are given in which the dimensional stability and use of fission fragment energy to induce chemical reactions (decomposition of NH_3 and CH_4) are demonstrated. (D.L.C.)

15644 HYDROCARBON RADIOCHEMISTRY. (to Esso Research and Engineering Co.). British Patent 864,225. Mar. 29, 1961.

A hydrocarbon radiochemical conversion process is outlined which comprises irradiating a gaseous or liquid hydrocarbon with high-energy ionizing radiation in the presence of activated carbon. The activated carbon has the advantages of greatly accelerating the irradiation process, isomerizing the converted hydrocarbons, and having a very

low neutron absorption cross section. The process has its greatest use in conversion of petroleum-derived oils, preferredly a distillate oil boiling in the range 150 to 950°F (paraffinic). The activated carbon may be impregnated with a catalytically active metal or a substance which emits α particles upon capture of neutrons. (D.L.C.)

Raw Materials and Feed Materials

15645 (MCW-1444) FACTORS THAT INFLUENCE THE SPONTANEOUS IGNITION OF MAGNESIUM THERMITE BOMB REACTORS. Topical Report. R. F. Leifield and S. W. Weidman (Mallinckrodt Chemical Works. Uranium Div., Weldon Spring, Mo.). Apr. 3, 1961. Contract W-14-108-Eng-8. 33p.

Methods were investigated for controlling the heating period of blended UF_4–Mg charges prior to spontaneous ignition. The satisfactory techniques had a common effect: direct or indirect alteration of the rate of Mg evaporation within the charge. Preignition heating periods were lengthened by decreasing the furnace temperature or the surface area of the magnesium, filming the magnesium with MgF_2 or with MgO, or removing free U and Mg from the bomb liner. Techniques that shortened preignition heating times included increasing the furnace temperature or the magnesium surface area, decreasing the UO_2F_2 concentration in the green salt, adding to the bomb charge or liner substances that scavenge H_2O and HF, or removing H_2O and HF from the charge by purging with helium. (auth)

15646 (NP-9948) MONTHLY REPORT [OF] DEVELOPMENT, FEBRUARY 1961. (Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa). 28p. (D-61-1).

Atmospheric carbonate leach tests were made on millhead samples. Diuranate precipitation using recycling techniques was investigated at progressively lower levels of excess NaOH. Scavenging studies of uranium from Beaverlodge barren solutions by amalgam reduction were continued. Yields are reported from the digestion of magnesium fluoride slag. Benefite M8 was used to improve the raffinate filtration. Work done in metal development studies included discussions on NRU and NRX production rods, heat treatment, Al–Fe alloys, Al–U alloys, Fe–U alloys, aluminum reduction of Blind River ADU powders, and ferrosilicon and Mg reduction of UO_2. The development of UO_2 ceramic material included investigations of continuous production, UF_6 conversion to UO_2, and fused UO_2, and work on a 12 kva induction furnace. (B.O.G.)

15647 METHOD AND EQUIPMENT TO PREPARE, THROUGH REDUCTION, POWDERS OR REDUCING METALS. (to Commissariat a l'Energie Atomique). Belgian Patent 567,500. May 31, 1958. (In French)

The reduction of UO_2 and ThO_2 is effected by means of calcium metal; the oxide is first mixed with calcium powder and compressed into a 2 lb pellet; this is then heated to 750 to 850°C in an enert atmosphere. The equipment used comprises a number of crucibles, isolated thermally from each other, sliding vertically through hot and cold zones. Grain size and purity are satisfactory. (EURATOM)

15648 IMPROVEMENTS IN ELECTRONIC SORTERS. FOR RADIOACTIVE MATERIALS. J. Sandier (to Commissariat a l'Energie Atomique). Belgian Patent 570,819. Priority date, Sept. 19, 1957. (In French)

Radioactive ores are fed continuously by a belt and pass within the range of a single scintillating detector coupled to an integrator. The integrated signals actuate several pneumatic ejectors according to the degree of activity of the samples. (EURATOM)

15649 IMPROVEMENTS IN THE PREPARATION OF URANIUM HEXAFLUORIDE. (to Commissariat a l'Energie Atomique). Belgian Patent 570,912. Priority date, Sept. 25, 1957. (In French)

The production of UF_6 due to the action of F_2 on UF_4 necessitates first the production of UF_5. It is found that, with the high temperatures necessary to produce a reasonably fast reaction, UF_5 powder becomes soft and has a tendency to conglomerate. To overcome this, a fluidizing bed is used. It consists of a material impervious to the action of UF_4 and F_2, for instance CaF_2, MgF_2, AlF_3, or CoF_3. This bed ensures also a better homogeneity of the process temperature. (EURATOM)

15650 FABRICATION OF METAL FLUORIDES. J. Sanlaville (to Commissariat a l'Energie Atomique). Belgian Patent 571,356. Priority date, Oct. 3, 1957. (In French)

Instead of preparing uranium fluorides with HF, the inventor uses hydrazine bifluoride and ammonium bifluoride with hexavalent uranium compounds such as UO_3, U_3O_8, UO_2F_2, or $U_2O_7(NH_4)_2$. The mixture is heated to 140°C, and the reaction produces a reduction as well as a fluorination. The complex obtained, UF_5NH_4, decomposes at 300 to 500°C into UF_4 and NH_4F with a yield better than 99%. (EURATOM)

15651 URANIUM RECOVERY FROM URANIUM-BEARING SHALES. P. Mouret, B. Parly, and P. Pottier (to Commissariat a l'Energie Atomique). Belgian Patent 573,037, Priority date, Dec. 17, 1957. (In French)

Uranium-containing shales are leached with an alkaline carbonate solution (pH = 10.5). The leach solution is clarified by oxidation with ozone and extracted by elution with a solution of sodium nitrate or chloride (pH = 7). The U values are recovered from the eluant by solvent extraction with a solution of TBP in kerosene, while the exhausted eluant is recycled. (EURATOM)

15652 IMPROVEMENTS IN THE ALKALINE TREATMENT OF URANIUM ORES USING ION EXCHANGE RESINS. P. Mouret, B. Parly, and P. Pottier (to Commissariat a l'Energie Atomique). Belgian Patent 576,166, Priority date, Mar. 6, 1958. (In French)

The alkaline leaching of U ores can be followed by an oxidation treatment with ozone. The leach solution is passed on an anionic resin which retains the U values. The U is washed out with an eluant (NaCl or $NaNO_3$) and precipitated as sodium uranate by adding NaOH. The residual alkaline solution is recycled on the resin, and the resulting solution treated with $Ca(NO_3)_2$ or $CaCl_2$ in order to reconstitute the primary eluant. (EURATOM)

Separation Processes

15653 (HW-66968) QUARTERLY REPORT. TECHNOLOGY OF NONPRODUCTION REACTOR FUELS REPROCESSING. BUDGET ACTIVITY 2790. V. R. Cooper (General Electric Co., Hanford Atomic Products Operation, Richland, Wash.). Contract AT(45-1)-1350. Oct. 3, 1960. 11p.

Operation of the 40-ton hydraulic shear equipped with a male Vee moving blade and semicircular stationary blade was continued, primarily to study blade life under varying conditions. Studies on methods of safely handling NaK-containing fuel elements were completed. Development work on the Zirflex and Sulfex processes was completed. Nitric acid leaching of swaged UO_2 from chopped fuel rods was investigated on laboratory and pilot plant scales. Stainless steel and Zircaloy-clad UO_2 rods 0.5-inch in diameter were used for the studies. Experiments were continued for determining criticality parameters of enriched

uranium pertinent to the reprocessing of power reactor fuels. (W.L.H.)

15654 (IDO-14542) SIMPLIFIED METHOD FOR THE CALCULATION OF FISSION-PRODUCT ACTIVITIES AND CONCENTRATIONS. B. E. Paige (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Nov. 30, 1960. Contract AT(10-1)-205. 18p.

The data and the equations are presented for simple and direct calculations of the concentration of fission-product elements and the activity of radionuclides in power reactor reprocessing solutions from burn-up data. The method is applicable to fuels from reactors with parameters of 10^{12} to 3×10^{13} neutrons per cm^2 second and 10^7 to 10^8 seconds irradiation time. (auth)

15655 (IEA-25) ON THE USE OF SODIUM TRIPHOSPHATE FOR THE SEPARATION OF ZIRCONIUM FROM HAFNIUM. G. Vicentini, M. Perrier, F. W. Lima, and E. Giesbrecht (Sao Paulo, Brazil. Universidade. Instituto de Energia Atomica). 1960. 6p.

The behavior of the system hafnium–zirconium sulfate–sodium triphosphate was examined by a labeling technique. The hafnium enrichment in the precipitate fraction indicates that the use of sodium triphosphate may be useful for a first fractionation on the classical separation problem associated with Hf–Zr. (J.R.D.)

15656 (ORNL-2976) MULTIKILOCURIE PRODUCTION OF KRYPTON-85. R. E. McHenry (Oak Ridge National Lab., Tenn.). Apr. 25, 1961. Contract W-7405-eng-26. 27p.

An adsorption process was developed and placed in operation for the recovery of multiliter quantities of radioactive krypton from fission gases resulting from spent-uranium fuel dissolution. The method is also useful for the separation of large quantities of purified xenon and may be useful for concentrating long-lived fission gases for storage. The raw fission gases were passed through charcoal at 900°C to convert the oxides of nitrogen to nitrogen and carbon monoxide. The gas was then adsorbed on activated charcoal at temperatures from −30 to −125°C. Elution of the adsorbed gas with helium through another activated charcoal column permitted the collection of separate fractions of krypton, xenon, and the other gases (mostly nitrogen). Collection was made in cold traps operating at liquid-nitrogen temperature. The chemical purity of the krypton product was >99% and the radiochemical purity of the Kr^{85} was essentially 100%. The xenon product purity was >98%. (auth)

15657 (ORNL-3055) RECOVERY OF Np-237 BY AN OXIDATION-REDUCTION FLUORIDE PRECIPITATION METHOD. R. D. Baybarz (Oak Ridge National Lab., Tenn.). Apr. 4, 1961. Contract W-7405-eng-26. 11p.

Several hundred grams of Np^{237} in nitric acid solution was ~95% recovered as NpO_2 of >99.5% purity. The remaining 5% was recovered as a nitric acid solution of 99.95% purity. The neptunium was oxidized to the soluble +6 state with sodium bromate, and Pu(IV), thorium, and other impurities in the solution were precipitated as fluorides. The neptunium was then reduced to Np(IV) with sulfur dioxide and precipitated as $KNpF_5$, dissolved in nitric acid, precipitated as neptunium oxalate, and calcined to the oxide. The recovered material balance was 99.91% with a process loss of 0.09%. (auth)

15658 (ORNL-3072) SULFEX PROCESS: ENGINEERING-SCALE SEMICONTINUOUS DECLADDING OF UNIRRADIATED STAINLESS STEEL-CLAD UO_2 AND UO_2–ThO_2. B. C. Finney and B. A. Hannaford (Oak Ridge National Lab., Tenn.). Apr. 4, 1961. Contract W-7405-eng-26. 33p.

An engineering-scale demonstration of the Sulfex (4 to 6 H_2SO_4) process indicated that semicontinuous decladding of unirradiated stainless steel-clad UO_2–ThO_2 fuels is feasible. In a long cylindrical dissolver, 4-in. ID by 19-ft high, solution bumping or foaming did not cause serious operational problems. For decladding of prototype Consolidated Edison UO_2–ThO_2 fuel assemblies, 2.8 to 4.0 hr was required. Soluble thorium losses to the clad solution varied from 0.022% in the absence of a heel to 0.25% in the presence of a heel. Soluble uranium losses were fairly constant, ~0.02%. Clarification of Sulfex clad solutions by gravity sedimentation and centrifugation produced a solid waste equivalent to 1.3 to 2.7% of the weight of the stainless steel dissolved in 4 M H_2SO_4. Mean particle size ranged from 3 to 7μ. Complete dissolution of waste solids by common aqueous reagents was not possible. (auth)

15659 (TID-6823) SEPARATION OF CARRIER-FREE SILVER FROM RHODIUM METAL FOIL. W. G. Smith (Purdue Univ., Lafayette, Ind.). [1960]. 6p.

A method for separating carrier-free silver from rhodium metal cyclotron target foils is described. The bombarded foil is electrically heated to the melting point with a tantalum resistance element and the silver is evaporated. The silver is further purified with anion resin exchange separations and then electroplated on platinum wire. (auth)

15660 (TID-7592(p.44-55)) FLUIDIZED BEDS IN REPROCESSING AND AS REACTOR FUELS. L. P. Hatch (Brookhaven National Lab., Upton, N. Y.).

An investigation is reported of the use of a fluidized-bed in the hydrochlorination and fluorination steps of reactor fuel reprocessing. Also discussed is fluidized-bed nuclear reactor development. (W.L.H.)

15661 (TID-7592(p.57-70)) USE OF FLUIDIZED-BED EQUIPMENT FOR ENRICHED URANIUM PROCESSING. R. P. Levey, Jr. (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.).

Experimental work is described in which readily fluidizable, reactive UO_3 was converted with high efficiency and at high rates to UF_4 in a batch reactor of conventional design with bed depths up to five diameters. Development of a tapered reactor in which bed turbulence is slight enough to permit operation with bed depths up to 15 diameters is described. Nonreaction studies with this equipment indicate that such reactors may be desirable for large-scale continuous-production work. Limited studies with pulsed-bed systems show that very fine feeds or mixtures of coarse and fine materials can be processed with reagent velocities 4 to 10 times the velocities possible in conventional systems, and that materials too fine or otherwise unsuitable for fluidization can be readily processed with this technique. (auth)

15662 (TID-11139) A STUDY OF THE LIQUID-LIQUID EXTRACTION AND SEPARATION OF SALTS. Interim Progress Report No. 9. Thomas E. Moore (Oklahoma State Univ., Stillwater. Research Foundation). November 1960. 9p. Contract No. AT(11-1)-71.

A spectrophotometric solvation and hydration study of the chlorides and perchlorates of Ni, Cu, and Co in the visible range was carried out in anhydrous solutions and in a series of solvents of variable water content. A calorimetric titration showed important differences in the nature of the hydration process for these compounds. The reaction of water with organic solutions was also studied. (J.R.D.)

15663 (TID-11196) EQUILIBRIUM EXTRACTION CHARACTERISTICS OF ALKYL AMINES AND NUCLEAR FUELS METALS IN NITRATE SYSTEMS. Progress Re-

Report No. 7, January 1–September 30, 1960. Edward A. Mason and Richard E. Skavdahl (Massachusetts Inst. of Tech., Cambridge). Nov. 1, 1960. For Oak Ridge Gaseous Diffusion Plant. Contract W-7405-Eng-26, Subcontract No. 327. 23p.

Programs completed include the stainless steel metals extraction studies and the effect of temperature on zirconium extraction. The species studied in the former were iron (III), cobalt (II), nickel (II), and chromium (III). These were in a nitric acid aqueous solution. At a constant initial aqueous metal concentration of about 50 gm/l and a constant initial amine concentration of about 0.3M, the effect of amine type (primary, secondary, and tertiary), hydrogen ion concentration, and nitrate ion concentration on the extraction ratio was investigated. Amines used for the study include trilauryl amine (TLA), a straight chain tertiary amine, di (tridecyl) amine (DTDA), a straight chain secondary amine, Amine S-24, a branched chain secondary amine, and Primene JMT, a branched chain primary amine. Toluene was used as the diluent for the entire study. Results showed that the stainless steel metals are not extracted to any significant degree by the amines considered from aqueous nitrate systems. Extraction ratios of 10^{-5} are typical for these metals. Experimental work on the temperature effect on zirconium extraction showed an activation energy of approximately 1 to 2 Kcal/mole for S-24 in Amsco or toluene and unpurified TLA in Amsco. The activation energy is about 5 Kcal/mole for purified TLA in toluene. Temperature effects are slight. The value of E_A^0 being less than a factor of two greater at 50°C than at 20°C. Severe amine degradation occurs at 50°C in 8M HNO_3. The ruthenium program has thus far consisted of an extensive literature search on ruthenium chemistry and solvent extraction, equipment specification and purchase, methods of solution preparation, and a proposed plan of attack. The literature search yielded conflicting conclusions as to the extractable ruthenium species in nitric acid solution. Two systems, the nitrato-nitrosylruthenium complexes and the nitro-nitrosylruthenium complexes, were chosen as the species to be studied under varying acid, salting, and extractant conditions. Methods of solution preparation for the two systems were found. (auth)

15664 (TID-11938) SOLVENT EXTRACTION. Henry G. Petrow (National Lead Co., Inc. Raw Materials Development Lab., Winchester, Mass.). Sept. 13, 1956. Contract AT(49-6)-924. 22p.

The criteria to be used in determining whether solvent extraction is applicable to a given feed material, and if so, which solvent, what type of equipment, and what operating conditions should be employed are discussed. The general advantages and disadvantages of solvent extraction are outlined. The efficiency of di(2-ethylhexyl) phosphoric acid (EHPA) in recovering uranium was examined. A flowsheet for the recovery of uranium from a sulfuric acid leach liquor with a 0.1M EHPA–0.1M TBP solution in kerosene is shown. Amines were found to have several definite advantages over EHPA as uranium extractants. The extraction of uranium by amines is analogous to the adsorption of uranium by anion exchange resins. A flowsheet for the recovery of uranium and molybdenum from leach liquor using an amine in kerosene is given. (M.C.G.)

15665 (TID-12472) SIMULATION OF A SOLVENT EXTRACTION PULSED COLUMN. P. H. Troutman and J. A. Consiglio (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Oct. 1, 1958. 49p. (58GL280)

Preliminary data on pulsed columns are reviewed, and an analog computer model was developed for simulating the steady state operation of pulse column. The over-all HTU was found to decrease with increasing frequency for 2A- and C-type columns, while it remained relatively constant for HA columns. The computer model was based on empirical correlations of the flooding behavior and over-all HTU for non-coalescing systems and can be used to evaluate the performance of 2A- and C-type columns in the non-coalescing region. The limitations of the treatment are discussed in detail. (D.L.C.)

15666 (AAEC/Trans-6) SOME SEPARATIONS OF RADIOISOTOPES USING ETHYLENEDIAMINETETRAACETIC ACID. G. Duyckaerts and R. Lejeune. Translated by P. S. Davis from J. Chromatog., 3: 58-62(1960). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 11883.

15667 (CEA-tr-R-1021) SEPARATION DU^{233} PA SANS ENTRAFNEUR, A PARTIR DU NITRATE DE THORIUM IRRADIE PAR LES NEUTRONS LENTS. (Separation of Pa^{233} Without Carrier, Starting with Thorium Nitrate Irradiated by Slow Neutrons). V. I. Spitsyn, and M. M. Golutvina. Translated into French from Atomnaya Energ., 8: 117-20(1960). 10p.

This was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 11539.

15668 (CEA-tr-R-1034) METHODES D'EXTRACTION DU RADIO-PHOSPHORE A PARTIR DE CIBLES CONTENANT DU CHLORE ET DU SOUFRE. (Methods of Separation of Radiophosphorus from Targets Containing Chlorine and Sulfur). N. A. Korshunov and A. I. Shatiev. Translated into French from Zhur. Neorg. Khim., 3: 100-3(1958). 11p.

The extraction of carrier-free phosphorus from different targets was studied. Targets of CCl_4, $CHCl_3$, S_2Cl_2, NH_4Cl, $MgCl_2$, $CaCl_2$, Na_2SO_4, $Na_2S_2O_3$, and KCNS were examined. It was found that radiophosphorus could be extracted from carbon tetrachloride by adsorption on silica gel, distillation under water, and adsorption on the walls of the irradiated tube. The best method for extraction from sulfur monochloride irradiated with neutrons is adsorption on silica gel. Extraction by boiling with carbonated water can be used to extract phosphorus from irradiated sulfur dissolved in chloroform or toluene. The extraction from solutions of salts used as targets can be carried out by adsorption on the hydroxides of aluminum or iron or on the insoluble precipitates $BaSO_4$ and $BaCrO_4$. (tr-auth)

15669 (CEA-tr-R-1068) SEPARATION DES RADIOISOTOPES LORS DE L'IRRADIATION DES COLLOIDES MnO_2. (Separation of Radioisotopes During Irradiation of Colloidal MnO_2). A. N. Nesmeyanov (Nesmeianov), B. M. Korolev, and L. A. Sazonov. Translated into French by N. Nedelko from Radiokhimiya, 1: 694-9(1959). 13p.

A study was made on colloidal MnO_2 to determine the effects of the quantity of isotope carrier, the pH of the colloidal solution, and the degree of exchange and the influence of different coagulants and surface-active substances on the separation of radioactive manganese obtained from the reaction $Mn^{55}(n,\gamma)Mn^{56}$. The results showed that the separation in colloidal systems, in certain cases, can be utilized in the presence of surface-active substances or of non-isotopic carriers. In the case where maximum enrichment is not the aim, a separation with a good yield is also possible with isotopic carrier. (tr-auth)

15670 (JPRS-9032) EXTRACTION OF RARE EARTH PRODUCTS OF FISSION WITH ORGANOPHOSPHORUS COMPOUNDS. E. (Ye.) N. Patrusheva, N. E. (Ye.) Brezhneva, and G. V. Korpusov. Translated from Radiokhimiya, No. 5, 541-8(1960). 12p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 5129.

15671 INORGANIC EXTRACTION STUDIES ON THE SYSTEM BETWEEN BIS(2-ETHYL HEXYL)-ORTHO-PHOSPHORIC ACID AND HYDROCHLORIC ACID. [PART] II. Kan Kimura (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 34: 63-8(Jan. 1961). (In English)

The influence of solvent concentration in extractions from hydrochloric acid solutions of about fifty elements is shown. The distribution ratio, K_d, of a given nuclide was radiometrically determined. The details of and some remarks on the method used are given. The bis(2-ethyl hexyl)-orthophosphoric acid concentration in the organic layer was varied in the range 0.5 to 50 volume % for most extractions. Extraction with barren toluene containing no HDEHP was also checked. The acidity in the aqueous layer was kept constant in a series of extractions of a given element. (N.W.R.)

15672 SEPARATION OF ZIRCONIUM AND HAFNIUM IN SULFURIC SOLUTION BY ANION EXCHANGER. B. Trémillon (Ecole de Physique et de Chimie, Paris), C. Cornet, M. Thibault, and J. Huré. Bull. soc. chim. France, No. 2, 286-94(Feb. 1961). (In French)

A procedure for the separation of zirconium and hafnium, using the partition of the anion sulfate complexes of these elements between an anion exchange resin and a sulfuric acid solution, was studied. The determination of the partition curves of these elements permits the understanding and the interpretation of the phenomena. In the concentration limits used and imposed by the stability of the solutions of Zr(IV) and Hf(IV), it was shown that (1) the hafnium is retained less by the resin (initially in the bisulfate form) than the zirconium; (2) an excess of sulfate in the aqueous solution is not favorable to the fixation of the two elements; and (3) the conditions necessary for the obtention of a displacement of Hf(IV) by Zr(IV) are not realizable and the Hf is always eluted by a sulfuric solution of the Zr. It is in 1.5 M sulfate medium (half sulfuric acid, half sodium sulfate) that the partition coefficients of the two elements are the most different and, consequently, the separation would be the easiest. A mixture Hf(IV) + Zr(IV) is made with a 0.15 M solution of pure zirconium sulfate (total sulfate 1.5 M). In these conditions, Hf is eluted from the Zr, which is accumulated in the frontal zone of the solution development but without undergoing dilution. The separation can be made continuously with the use of columns with moving resin beds. (tr-auth)

15673 ON THE REFINEMENT OF URANIUM WITH BENZYLDODECYLAMINE. Yoshinaga Oka, Taro Yamasaki, Shigeki Matsuo, and Mihoko Abe (Tohoku Univ., Sendai). J. At. Energy Soc. Japan, 3: 110-16(Feb. 1961). (In Japanese)

Using benzyldodecylamine, the effects of variables such as uranium loading, acid concentration, and sulfate ion concentration on uranium extraction from acidic aqueous sulfate systems were studied. Uranium was effectively extracted in the concentration range 0.1 to 1.0 M/l sodium sulfate in the acidity range of 0.1 to 1.0 N. Some further studies were performed to extract uranium from highly concentrated solutions with concentrated benzyldodecylamine solution and to separate impurities contained in yellow cakes. It was found that benzyldodecylamine is one of the useful solvents to refine yellow cakes. (auth)

15674 EFFECT OF THE DRYING TEMPERATURE ON THE ION-EXCHANGE PROPERTIES OF ZIRCONIUM PHOSPHATE. G. Alberti and A. Conte (C.N.R.N., Rome). J. Chromatog., 5: 244-53(Mar. 1961).

The ion-exchange properties of zirconium phosphate, dried at temperatures ranging from 150 to 850°, are compared with those of zirconium phosphate dried at 50°. In addition to partially irreversible dehydration, permanent changes in certain properties of zirconium phosphate dried at temperatures above 150° could be observed. Variations in selectivity for certain ions of ZP dried at high temperature can be employed to improve the separation of these ions from each other. All phenomena observed can be explained by the assumption that an increase in drying temperature causes a greater condensation in the structure of the exchanger. (auth)

15675 AUTOMATIC RECORDING OF THE RADIOACTIVITY OF ZONES ELUTED FROM THE GAS-LIQUID CHROMATOGRAM. A. T. James and E. A. Piper (National Inst. for Medical Research, London). J. Chromatog., 5: 265-70(Mar. 1961).

A simple proportional flow counter for use with the gas chromatogram is described, which is operated at room temperature by burning all eluted material to CO_2 over heated copper oxide. The gas stream is dried, 5% CO_2 is injected and the mixture passed into the counter. Details are given of the necessary circuitry. Examples are provided of its use with long chain fatty acids. (auth)

15676 EXTRACTION EQUILIBRIA IN THE SYSTEM AQUEOUS HYDROCHLORIC ACID-URANYL CHLORIDE-TRI-N-BUTYL PHOSPHATE. A. S. Kertes and M. Halpern (Hebrew Univ., Jerusalem). J. Inorg. & Nuclear Chem., 16: 308-22(Feb. 1961). (In English)

The distribution of uranyl chloride between aqueous hydrochloric acid solutions and undiluted tri-n-butyl phosphate (TBP) was examined as a function of increasing acid concentration in the initial aqueous solution, the metal concentration being kept constant, and as a function of increasing uranyl chloride concentration for constant acid content of the initial aqueous solution. The pregnant organic layers involved were investigated by means of volume-swelling determinations, and by viscosity, density, conductivity and spectrophotometric measurements. The water content of the tri-butyl phosphate layer was also determined. It was found that the chemical mechanism governing the extraction of uranyl chloride is largely dependent upon the hydrochloric acid concentration in the initial aqueous solutions. For low acid concentrations the mutual salting-out effect of the two solutes controls the mechanism; at medium acid concentrations (1 to 7 M HCl) the acid concentration has no marked influence on the extraction mechanism involved; at high acid concentrations it is the competition between two complex-solvates, namely the hydrochloric acid-monosolvate-trihydrate and the uranyl chloride-disolvate, which controls the extraction of uranyl chloride from aqueous solutions. (auth)

15677 A SUMMARY OF TTA EXTRACTION COEFFICIENTS. A. M. Poskanzer and B. M. Foreman, Jr. (Brookhaven National Lab., Upton, N. Y.). J. Inorg. & Nuclear Chem., 16: 323-36(Feb. 1961). (BNL-4758). (In English)

Extraction with organic solutions of 2-thenoyltrifluoroacetone (TTA) has proved to be a versatile and powerful method for radiochemical separations. A summary of the data in the literature is presented. In general, the logarithm of the extraction coefficient is linear with pH at constant TTA concentration. The slope of this linear relationship and the pH of 50 per cent extraction for 0.2 M TTA in benzene are presented for forty-eight elements in the form of a periodic table. A graph is given by which one may quickly estimate per cent extraction as a function of pH. An equation for the variation of extraction with TTA concentration is given and the effect of changing the or-

nic solvent is discussed. New experimental data are resented for the extraction of Pa(V) and Fe(III) from drochloric acid. (auth)

15678 DINONYL NAPHTHALENE SULPHONIC ACID ND TRI-n-OCTYLAMINE AS LIQUID ION-EXCHANGERS OR THE STUDY OF Fe(III) AND In(III)-CHLORIDE COM-LEXES. J. M. White, P. Kelly, and N. C. Li (Duquesne niv., Pittsburgh). J. Inorg. & Nuclear Chem., 16: 337-44 Feb. 1961). (In English)

The stability constant of the 1:1 Fe(III) chloride complex t ionic strengths varying from 0.20 to 1.00 is independent of whether H^+ or Na^+ is the cation of the perchlorate ion. The pecific ion effect on the stability of the $FeCl^{2+}$ complex bove 5 M, therefore is absent at these lower ionic strengths. or In(III), substitution of Na^+ for H^+ as cation of the per-hlorate ion decreases the log K_1 of $InCl^{2+}$ by about 0.3 at onic strengths of one and two. The presence of the specific on effect on the In–Cl system at ionic strengths one and wo and the absence of the effect on Fe–Cl system is not surprising since In(III) forms much more stable complexes with Cl^- than Fe(III). No extraction of the Fe(III) and In(III) by the anionic exchanger, tri-n-octylamine hydrochloride, in perchloric acid solutions, less than 2 M, has occurred. This indicates that perchlorate ion does not form a negatively charged complex with Fe(III) or In(III) in the organic phase. The distribution coefficients of Fe(III) and In(III) are directly second power dependent upon the tri-n-octylamine hydrochloride concentration in the benzene phase, suggesting that the negatively-charged complexes $FeCl_5^{2-}$ and $InCl_5^{2-}$ complexes are formed in the organic phase. (auth)

15679 THE RAPID SEPARATION OF ^{24}Na FROM ^{27}Mg. E. Cerrai and F. Gadda (CISE, Milan). J. Inorg. & Nuclear Chem., 16: 356-8(Feb. 1961). (In English)

To develop a method suitable for the separation and detection of radionuclides having a half-life of about 10 to 20 min, the separation of 14.9 hr Na^{24} from 9.6 min Mg^{27} was studied. The radioisotopes were produced by the nuclear reactions $Al^{27}(n,\alpha)Na^{24}$ and $Al^{27}(n,p)Mg^{27}$, using 14 Mev neutrons from a tritium target bombarded with deuterons from a 400-kev Cockcroft and Walton accelerator. Since the separation procedure must operate in the presence of relatively large amounts of aluminum from dissolution of the irradiated target, the procedure was based on the inability of the resin to retain sodium and on the different stabilities of the EDTA complexes of magnesium and aluminum. At pH 7.5 to 8 both chelates are retained by the resin, but since the aluminum chelate remains stable over a wide pH range (3 to 10) while the magnesium chelate is less stable at the lower pH, the latter can be eluted from the resin with 1 N acetic acid. (N.W.R.)

15680 INFLUENCE OF THE CHELATING AGENT ON THE SEPARATION OF Eu^{3+} AND Am^{3+} IONS BY SOLVENT EXTRACTION. D. Ryrssen, M. Haffez, and T. Sekine (Royal Inst. of Tech., Stockholm). J. Inorg. & Nuclear Chem., 16: 367-8(Feb. 1961). (In English)

The distribution ratio (chloroform/water) with β-isopropyl tropolone is $q_{Eu} \approx q_{Am}$ and with 5,7-dichloro-oxine $q_{Eu} < q_{Am}$. This gradual change of order seems to be parallel to the basicity of the liquid-forming atoms in the complexing agents. Hence the oxygen atoms in β-isopropyl tropolonate are less basic than the nitrogen and oxygen atoms in 5,7-dichloro-oxinate. Qualitatively, an increase in basicity and chelating power (stability constant) of the ligand will increase q_{Am}/q_{Eu}. This relationship may facilitate the choice of a suitable chelating agent for the separation of Eu(III) and Am(III). (N.W.R.)

15681 THE ISOLATION OF RADIOSILVER BY ISOTOPIC EXCHANGE. M. Peisach and S. J. Van Der Walt (South African Council for Scientific and Industrial Research, Pretoria). J. S. African Chem. Inst., 12: 116-18 (1959). (In English)

Sources of Ag^{111} can be prepared by isotopic exchange between dissolved and solid Ag salts. A study was made of the exchange reaction as well as of the subsequent electrolytic recovery of exchanged silver to see how far the weight of AgI can be reduced without affecting the radiosilver recovery. It is concluded that about 1 mg silver iodide is required. Since this amount of carrier produces a relatively thick source, the method of isotopic exchange cannot be used to prepare sources of radiosilver for nuclear spectroscopy. (N.W.R.)

15682 PROCESSING OF ZIRCONIUM SUITABLE FOR SELECTIVE STRIPPING OF ZIRCONIUM CLAD FUEL ELEMENTS. (to Centre d'Etude de l'Energie Nucleaires). Belgian Patent 565,789. Apr. 15, 1958. (In French)

Zirconium- or zircaloy-canned fuel elements are leached with a hot compound of sodium fluoride and an organic acid, preferably oxalic or citric acid. The dissolved zirconium is converted into insoluble hydroxide by addition of ammonia and can easily be recovered with a high degree of purity. Uranium is not affected by this process. (EURATOM)

15683 PROCESS FOR RECOVERING METAL VALUES UTILISING ORGANIC ORTHOPHOSPHATE EXTRACTANTS. (to U. S. Atomic Energy Commission). British Patent 862,204. Mar. 1, 1961.

Superior results in solvent extraction processes for recovery of metals, e.g., uranium, vanadium, etc., may be obtained by the use of a special class of organic orthophosphates as extractants. These orthophosphates are either mono- or mixtures of mono- and di-alkyl orthophosphoric acid esters with the organic substituents having from 9 to 17 carbon atoms. The preparation of such orthophosphates and their use for metal recovery from mineral acid solutions, aqueous slurries, nonaqueous slurries, and solid leaching processes are discussed in detail. Flowsheets, graphs, and examples are included illustrating each mode of metal recovery and uranium and vanadium recovery from leach solutions. The stripping of metal values from organic phases is also treated. (D.L.C.)

15684 PROCESS FOR THE REDUCTION OF PLUTONIUM. (to Commissariat a l'Energie Atomique). British Patent 862,352. Mar. 8, 1961.

A method for reducing plutonium(IV) to (III) is given which can be applied to the separation of plutonium from uranium. The reduction is carried out with ascorbic acid, and, in the application to plutonium separation, an organic solution of uranyl and plutonium(IV) nitrates is contacted with an aqueous solution of ascorbic acid in the presence of free HNO_3; the reducing action extracts the plutonium into the aqueous phase. The proportion of the ascorbic acid used should be 1.5 to 15 moles per mole of plutonium nitrate. (D.L.C.)

15685 SEPARATION OF PLUTONIUM AND FISSION PRODUCTS FROM URANIUM. (to United Kingdom Atomic Energy Authority). British Patent 863,571. Mar. 22, 1961.

A process for separating plutonium from irradiated uranium is given which avoids large volumes of solutions. In this process, irradiated uranium is dissolved, uranium is converted to uranyl ions, plutonium is kept in an oxidation state not greater than 4, and a uranyl salt is precipitated from the solution. About 75 to 80% of the plutonium is recovered in the solution, and the precipitation may be re-

peated on the crystallized salt to recover the plutonium therefrom. Precipitation may be carried out by increasing the acid concentration of the solution or by cooling a hot solution. (D.L.C.)

15686 SEPARATION OF U^{233} BY EXTRACTION. (to United Kingdom Atomic Energy Authority). British Patent 863,845. Mar. 29, 1961.

A process is given for the separation of U^{233} from irradiated thorium. In this process, irradiated thorium compounds are dissolved in nitric acid and subjected to a plurality of precipitations and redissolving steps with MnO_2 carrier which carries Pa^{233}. Pa^{233} is redissolved and the solution stood for a period sufficient to convert Pa^{233} to U^{233}, which is then extracted by diethyl ether in the presence of nitrate ions. (D.L.C.)

15687 METHOD OF REFINING URANIUM. (to United Kingdom Atomic Energy Authority). British Patent 864,411. Apr. 6, 1961.

A method is given for refining impure uranium produced by electrolysis or by other reduction processes. In this method, impure uranium is melted in a fused salt bath containing an alkali metal halide and an alkaline earth metal halide, and after a suitable interval, molten purified uranium is allowed to coalesce and then is removed from the bath. A particularly suitable bath is one containing KHF_2 and $BaCl_2$. The purifying action probably resides in a combination of vaporization and dissolution and/or retention of impurities in the salt bath. In this way, uranium may be purified from oxide and salt impurities and metals such as sodium, and steps such as crushing, washing, grinding, sintering, etc., may be eliminated. (D.L.C.)

15688 REFINING URANIUM. (to United Kingdom Atomic Energy Authority). British Patent 864,576. Apr. 6, 1961.

A method and an apparatus for refining uranium metal are described in which nonvolatile impurities are removed as well as volatile ones. In the apparatus, a uranium mass is supported on a strainer in a vacuum of 10 μ Hg or less. Induction heating causes the uranium to melt and flow through the strainer; vaporized impurities condense on a nearby surface, while unvaporized impurities collect on the strainer. After the process of melting, straining, and solidification of the uranium mass is completed, the mass is further cooled at a rapid rate by introducing an inert gas into the apparatus. (D.L.C.)

15689 RECOVERY OF RARE REFRACTORY METALS. (to United Kingdom Atomic Energy Authority). British Patent 864,640. Apr. 6, 1961.

An electrolytic cell for recovery of rare refractory metals such as uranium and thorium is described wherein the volatile impurities in the deposited metal are eliminated. A salt of the rare refractory metal is introduced into the fused salt electrolyte at a point between the anode cell wall and a shield electrically connected to the anode cell and dipping into the electrolyte so that the point has substantially no electric field and volatile impurities are vaporized before reaching the cathode. This cell is particularly useful in reducing the boron content of uranium. A simpler modification of the electrolytic cell is described in British Patent 864,641. (D.L.C.)

15690 RECOVERY OF RARE REFRACTORY METALS. (to United Kingdom Atomic Energy Authority). British Patent 864,641. Apr. 6, 1961.

An electrolytic cell for recovery of rare refractory metals such as uranium and thorium is described wherein the volatile impurities in electrolytically deposited metal are substantially eliminated. A salt of the rare refractory metal is introduced into the fused salt electrolyte at a point adjacent to the anode cell wall and remote from the cathode so that the volatile impurities in the salt are vaporized before reaching the cathode. This method of reducing impurity levels is particularly applicable to uranium green salt, whose B_2O_3 impurity may be reduced from several ppm to little or no boron in the deposited uranium. A modification of the electrolytic cell is described in British Patent 864,640. (D.L.C.)

15691 PROCESS FOR SEPARATION OF PROTACTINIUM FROM A SOLUTION OF NEUTRON-IRRADIATED THORIUM. (to U. S. Atomic Energy Commission). British Patent 865,011. Apr. 12, 1961.

A process for the separation of protactinium-233, thorium, and uranium-233 from neutron-irradiated thorium–nitric acid solution is presented. It comprises contacting feed solution with an extracting solution of a trialkyl phosphate in an inert organic diluent, thereby extracting uranium and thorium into the resulting organic phase while confining protactinium-233 and fission products to the resulting aqueous phase. Any small amounts of protactinium and fission products are scrubbed from resulting organic phase with a solution comprised of an aqueous solution of an inorganic nitrate salt, the total nitrate ion content of feed solution and scrubbing solution being less than the stoichiometric content required by the cations of solution and scrubbing solution, thereby providing a net nitrate ion deficiency for the combined extraction and scrubbing operation. The protactinium-233 and fission products-containing aqueous phase is then separated from the uranium-233 and thorium-containing organic phase. (N.W.R.)

15692 REMOVAL OF RADIO-ACTIVE STRONTIUM AND CESIUM FROM MILK. (to Canadian Patents and Developments Ltd.). British Patent 865,042. Apr. 12, 1961.

A simple method is given for removing Sr and Cs from milk without altering the natural flavor or composition of the milk. The method consists of treating the milk with a cation exchange resin, e.g., Dowex 50 W, which is saturated with Ca, K, and Na, whereby only Sr and Cs are absorbed. The resin may be prepared by incorporating in it Ca, K, and Na in the same weight ratio as that found in milk, 1 : 1.33 : 0.42. An example of the method is given in which 100 parts contaminated milk agitated with 1 part resin for 2.5 min resulted in 58 and 92% removal of Sr and Cs for one and two treatments, respectively. (D.L.C.)

15693 URANIUM RECOVERY PROCESS. John Walker Stevenson and Robert George Werkema (to U. S. Atomic Energy Commission). British Patent 865,095. Apr. 12, 1961.

A process is outlined for recovering U from MgF_2 slag with minimum fluoride contamination. The process comprises grinding the slag, roasting the slag in air or CO_2 to convert U to U_3O_8, contacting the roasted slag with an aqueous solution containing $\geq$ 8 wt.% $NaHCO_3$ and some Na_2CO_3, separating the U-containing product liquor from the residue, and adding an alkali metal hydroxide to the liquor to precipitate the U. The process can be improved by adding small quantities of Na_2CO_3 or $NaHCO_3$ to the slag before roasting and adding an oxidizing agent to the leach solution, and other ways of improving the process are discussed. With this process, it is possible to reduce the U content of slag from 5 to 0.05%. (D.L.C.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

15694 (AAEC/E-56) DEVELOPMENT OF A TEN-STAGE MIXER-SETTLER FOR U235 SOLUTIONS. PART 2. M. G. Baillie and R. C. Cairns (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Dec. 1960. 21p.

Experimental work on a ten-stage mixer-settler is described. The effects of impeller position and flow rate on its operation and the inactive extraction efficiency under conditions similar to those in reprocessing of HIFAR fuel elements are treated. Equilibrium data were determined for the systems used, and a method was developed for interface detection over a wide range of solution concentrations. The mixer-settler is shown to be hydrodynamically practicable. It was found that interface height is controlled satisfactorily by correct positioning of the impeller above the mixer base and that the pump mix type of impeller is not essential. (auth)

15695 (BM-RI-5764) GAS-FIRED VACUUM RETORT FOR DISTILLING METALS. H. S. Caldwell, Jr., H. W. St. Clair, J. H. Bilbrey, Jr., and M. J. Spendlove (Bureau of Mines. College Park Metallurgy Research Center, Md. and Bureau of Mines, Washington, D. C.). June 1960. 11p.

A gas-fired vacuum retort consisting of a hollow, cylindrical graphite liner encased in a thin shell of stainless steel was developed. The retort was used to distill zinc from dross and die-casting scrap. More than 99% of the zinc was recovered as a condensate containing 99.8 to 99.9% zinc. Distillation rates of 50 pounds of zinc per hour were attained at a temperature of 65°C. with pressures ranging between 50 and 100 μ. The retort was found to be suitable for distilling other volatile metals such as cadmium and magnesium. (auth)

15696 (CF-61-3-11) GC-ORR LOOP II FILTER TESTS. F. A. Flint and R. E. MacPherson (Oak Ridge National Lab., Tenn.). Mar. 3, 1961. 13p.

Tests of Flander's Airpure filters, stock number 6G31R-C, size C, specified for use in the GC-ORR Loop No. 2 as full-flow, primary coolant filters have demonstrated that this equipment is unsatisfactory for the intended application. D.O.P. (dioctylphthalate) efficiency tests were carried out on two filters in as received condition and after typical thermal cycles. Only one unit met the design criteria of 99.9% efficiency for removal of 0.6 micron particles in the as received conditions, and this unit was subsequently damaged by thermal cycling. (auth)

15697 (IEA-36) A VERSATILE AND INEXPENSIVE PIPPETING DEVICE FOR RADIOACTIVE AND OTHER DANGEROUS LIQUIDS. Fausto Walter Lima (Sao Paulo, Brazil. Universidade. Instituto de Energia Atomica). 1960. 3p.

Design and operation of a system for pipetting small or large volumes of radioactive, poisonous, or corrosive liquids are described. The system will accommodate pipetts which measure less than 1 ml to 100 ml. The system is inexpensive and can be made at the laboratory. (J.R.D.)

15698 (NP-9922) DESIGN CHARTS FOR R/C BEAMS SUBJECTED TO BLAST LOADS. Final Report. Technical Report 121. J. R. Allgood and G. R. Swihart (Naval Civil Engineering Lab., Port Hueneme, Calif.). Oct. 19, 1960. 13p.

Supersedes NP-8805 (Technical Report 069).

An ultimate load theory is combined with an idealized dynamic theory to form a computational program for the development of a set of 90 design charts for reinforced concrete beams. The behavior of beams under blast loading is reviewed to aid in the explanation of the computational program and the charts. A procedure for the treatment of shear and bond is presented, the design curves are given and exemplified, and their limitations are discussed. (auth)

15699 (RADC-TR-60-159) SURVIVAL OF GROUND ELECTRONIC SYSTEMS FROM NUCLEAR ATTACK. Dana A. Benson, K. D. Kirk, and Stanley M. Ostergren (Rome Air Development Center, Eriffis AFB, N. Y.). Oct. 1960. 45p. (AD-246449)

A discussion is given of the planning, design, and fabrication of ground electronic equipment systems. The general aspects and basic approaches to the survival problem are presented. The mathematics and probability theory were simplified, but for a given application they may be expanded to include all the related possibilities, combinations, and influence factors. (auth)

15700 (TID-11073) ANALYSIS OF GAS LEAKAGE THROUGH STATIONARY SEALS. M. P. Wilson, Jr. (General Dynamics Corp. Electric Boat Div., Groton, Conn.). October 3, 1958. 30p. (MGCR-P-316)

The leakage of CO_2 and He are not significantly different when the flow can be described by Poiseuille's laws at 0 to 250°F. Therefore, the leakage through this type of seal should not have a significant bearing on the selection of the working fluid. However, if leakage occurs through cracks and seals having dimensions close to the mean free path of the molecule, the leakage of He would be greater than that of CO_2. It is expected that in this type of leakage, the leakage of He would not surpass the leakage of CO_2 by more than a factor of three. If the gap is equal to the molecular diameter of CO_2, no leakage could be expected and flow derived by kinetic theory would not be valid. The molecular diameter of CO_2 is 4.18A and that of He is 2.18A. If there are cracks of this size, and many of them, leakage of He could occur when there is no leakage of CO_2. Then the analysis based on a spacing of 10^{-8} inches is not valid for either of the gases but does represent the relative magnitude produced by the different methods of analysis if the gap approaches the mean free path. The property that should be given most consideration is solubility. Regardless of gas selection the problems of oil diffusion into the system and gas dissolving into the oil must be considered. Solubility might be desirous, however this requires a more thorough investigation. It may be possible to prevent oil diffusing into the system by placing labyrinth seals on the gas side of the typical seal mentioned, to act as a buffer to the oil leakage. A separate supply of gas could be used to

continuously purge the buffer seal. This would require continuous purification of the buffer gas. The problem of gas absorption by the oil could be solved by continuous purification of the oil. In the event CO_2 is used, a rise of temperature and a decrease in pressure would tend to drive the dissolved gas out; whereas, He would require a decrease in temperature and a decrease of pressure. The analysis is based on a static seal and theoretically would be applicable to rotating seals. However, such effects as surface temperature of a rotating seal and pumping due to uneveness of the seal surface tend to increase the leakage through seals. (auth)

15701 (TID-12498) A LARGE-VOLUME WATER SAMPLER. Robert Gerard and Maurice Ewing (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory). Mar. 1961. Contract AT(30-1)1808. 13p. (CU-11-61-AT(30-1)1808 Geol).

A 220-liter sampler is described which has been used successfully to collect more than 300 subsurface water samples for radioisotope measurement. The water sampler is fitted with a single door which can be sealed securely with an "O" ring seal. A reversing thermometer pair and a bourdon recorder are provided to indicate the depth of closing. The sampler can be made for use with an hydrographic wire or a larger diameter trawl wire. An inert plastic lining may be applied to the sampler for the collection of samples which are affected by metal contact. (D.L.C.)

15702 (VDIT-31) STEAM-SEPARATION. A Literature Search. Ernst Bock (Aktiebolaget Atomenergi, Stockholm). Feb. 1961. 10p.

An annotated bibliography is given, consisting of 32 references, as a general introduction and survey on steam separation. Design problems in reactor technology were decisive in the selection of the abstracts. (B.O.G.)

15703 (DEG.-Inf.-Ser.-13) HYDRODYNAMIC SEAL FOR ROTATING SHAFTS. E. F. Boon and S. E. Tal. Translated by R. Presser (U.K.A.E.A., Risley) from Chem.-Ingr.-Tech., 31: 202-12(1959). 31p.

A hydrodynamic seal for rotating shafts is described, which operates with very low leakage losses, below 5 g/year. The seal consists mainly of a threaded portion which runs inside a sleeve, the threaded part conveying a sealing liquid against the pressure within the seal. This type of seal is referred to as a viscoseal. It is possible to achieve a tight seal even when the shaft is stationary by introducing special constructional measures. The seal is of considerable interest, e.g., when toxic gases are used in the chemical industry. The possible types of construction with single thread or with counter-running thread are described. Derivations are given of equations for the sealing pressure and for the power requirement. An example for this type of seal is calculated for technical application in a reactor. The influence of properties on the method of construction is described, and the presentation of test results is explained, using dimensionless values for the seal. (auth)

15704 ULTRA-HIGH VACUUM. G. Lewin. Endeavour, 20: 85-91(Apr. 1961).

The gas kinetic data for air are tabularly presented for a general discussion. The measurement of ultra-high vacuum, the process of evacuation, the design of vacuum systems, and the pumping systems for ultra-high vacuum are discussed. (N.W.R.)

15705 DISMOUNTABLE JOINT FOR METAL CONDUITS. (to Commissariat a l'Energie Atomique). British Patent 863,390. Mar. 22, 1961.

A dismountable joint for metal conduits is designed which is easily fitted and dismantled and which can hold a vacuu of 10^{-6} mm Hg while being degassed by stoving. In the joint, the opposed surfaces of the two conduits (copper or brass) which are to be sealed together are covered with a thin (10 to 20 μ) coating of a soft metal, preferably indium and the conduits are clamped together by members which form a nut-bolt arrangement. (D.L.C.)

15706 IMPROVEMENTS IN OR RELATING TO REFIN ING A BAR OF MATERIAL BY ZONE MELTING. Alfred John Martin and Ronald Andrew Knight (to United Kingdom Atomic Energy Authority). British Patent 863,493. Mar. 22, 1961.

A zone-refining apparatus is described which enables zone melting of bars of any size without breakup of the molten zone. In this apparatus, the bar to be treated is held in a vacuum chamber by one end on a support means to which are fixed upwardly extended molybdenum rods with ceramic sleeves in contact with the bar; the sleeve-bar contact lends support to the molten zone. Heating is done with an induction coil. (D.L.C.)

15707 IMPROVEMENTS IN AND RELATING TO FLANGED JOINTS. Peter McGregor Ross, Frank Medcalfe, and John Charles Drumm (to C. A. Parsons & Co., Ltd.). British Patent 863,647. Mar. 22, 1961.

A seal welded flanged joint is designed which can be opened as often as necessary. In this joint, each flange has a recess formed adjacent to the place where the seal weld is to be made so that the recesses of both flanges form a channel into which a U-section removable member is placed. A seal weld is then formed between an outer peripheral face of each leg of the U-section member and the channel side. (D.L.C.)

15708 IMPROVEMENTS IN OR RELATING TO METHODS AND APPARATUS FOR CONTACTING LIQUIDS. John Desmond Thornton (to United Kingdom Atomic Energy Authority). British Patent 864,677. Apr. 6, 1961.

An efficient and simple liquid-liquid contactor is designed which is capable of operation with radioactive liquids behind a massive shield and with minimum maintenance. The contactor comprises a plurality of chambers connected in series, the chambers preferably being formed by partitioning a long cylindrical chamber. Each partition comprises two spaced plates, one apertured near its upper edge and the other apertured near its lower edge. In operation, a pulsating movement is induced in the liquids throughout the series system whereby, in one direction of the pulsation, the light phase flows downstream through the partitions and, in the other direction of the pulsation, the heavy phase is pumped upstream through the partitions. Extraction data are reported for a water-toluene system with acetone as solute. (D.L.C.)

Heat Transfer and Fluid Flow

15709 (57GL54) LAMINAR INCOMPRESSIBLE FLOW BETWEEN NON-CONCENTRIC CIRCULAR CYLINDER. H. Poritsky and F. A. Fend (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Jan. 29, 1957. 13p.

A solution is obtained for the velocity distribution for laminar flow between eccentric circular cylinders. The axial component of the velocity is obtained from the Navier-Stokes equations and satisfies Poisson's equation. The solution is obtained by superposing upon a simple solution w_1, which depends only on the distance from the center of the inner circle, a solution w_2 of Laplace's equation such that $w_1 + w_2$ vanishes along the boundaries. The latter solution is obtained by conformally mapping the area between

...he eccentric circles on the area between concentric cir-...cles. A numerical example is given for an eccentricity of ...0.5. For this case, the velocity profile at the narrowest ...section is nearly parabolic and agrees closely with that be-...tween concentric cylinders with the same gap and same ...inner diameter. (auth)

15710 (ARL-4) HEAT TRANSFER IN SEPARATED FLOWS. PART I. PRELIMINARY EXPERIMENTS ON HEAT TRANSFER FROM AN INFINITE BLUFF PLATE TO AN AIR STREAM. PART II. SURVEY ON SEPARATED FLOWS, WITH SPECIAL REFERENCE TO HEAT TRANSFER. H. H. Sogin, Kurt Burkhard, and P. D. Richardson (Brown Univ., Providence). Jan. 1961. Contract AF33(616)-5756. 114p.

Measurements were made of local rates of heat transfer on the front and back surfaces of an infinite flat plate strip oriented normal to an air stream at atmospheric pressure and temperature. The chord length of the plate was 6.75 in., and its wind-tunnel blockage ratio was 0.211. The data, reduced with property values at the mean film temperature, were well correlated by an equation of the type $hL/k \sim Re^{\frac{1}{2}}$. Effects of turbulence grids and of a splitter plate at the rear were also included. The plate constitutes a basic apparatus for the study of heat transfer to regions of separated flow. The present knowledge of the onset, development, and nature of separated flows together with the corresponding heat transfer characteristics are outlined. In conclusion an extensive bibliography is given. (auth)

15711 (ATL-A-118) EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF ULTRASONIC VIBRATIONS ON BURNOUT HEAT FLUX WITH BOILING WATER. Quarterly Technical Progress Report, January–March 1961. ATL Job 4116. F. E. Romie (Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.). Contract AT(04-3)-250. 7p.

In this investigation, the effect of an ultrasonic field on the maximum nucleate heat flux (burnout) that can be sustained by boiling water in a flow system will be determined. The water will flow in the direction of sound propagation within an annular flow channel bounded on the outside by a glass tube and on the inside by a 0.25-in. OD heating element. The design of the test section and flow system is given. (D.L.C.)

15712 (CF-59-11-1(Add.I)) ADDENDUM TO FLOW STABILITY IN HEAT TRANSFER MATRICES UNDER BOILING CONDITIONS. A. P. Fraas (Oak Ridge National Lab., Tenn.). Mar. 22, 1961. 9p.

Information on effects not treated in the original memorandum is presented. Included are discussions of static head effects, the effects of differences in heat addition rates between parallel channels coupled with common headers, and effects of orifices at the inlet to the economizer. (J.R.D.)

15713 (CVNA-76) STUDY OF FLOW TRANSIENT IN A CLOSED CHANNEL PRESSURE TUBE REACTOR. J. M. Geets and H. H. Norman (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). June 1960. 93p. For Carolinas Virginia Nuclear Power Associates, Inc., Charlotte, N. C.

A study was made to determine if and when core thermal damage occurs during various flow transients in a closed channel pressure tube reactor. For this purpose, a mathematical description of the system, amenable to the analog computer, was derived. The reactor used for the study was a vertical pressure tube moderated and cooled with heavy water. The analog model was used to obtain conservative design requirements such as scram time and primary coolant system inertia. Hot channel flow and total flow were compared for a complete loss of power to the primary coolant pumps. An investigation of flow redistribution for steady state flow showed that it increased slightly when the reactor power increased beyond its nominal value. An increase of reactor power to approximately 170% of its rated value would be required to produce an appreciable flow reduction in the hot channel. Unfavorable flow redistribution or flow choking always resulted in departure from nucleate boiling. Enthalpy and flow transients are shown after the occurrence of a complete loss of power to both primary coolant pumps. The influence of the inertia requirements of plant parameters such as steady-state core pressure drop, inlet water enthalpy, and steady-state flow, was also investigated. (M.C.G.)

15714 (DEG-Report-307) THERMAL STRAINS IN A HEAT PRODUCING ELASTIC-PLASTIC CYLINDER. J. P. Ellington (United Kingdom Atomic Energy Authority. Development and Engineering Group, Risley, Lancs, England). Jan. 16, 1961. 11p.

Using Tresca's yield criterion and its associated plastic potential an analytical solution is found for the stresses, strains and displacements in a free-ended heat-producing cylinder of a compressible non-work-hardening material. The solution is found to be applicable for temperature differences up to twice that necessary to initiate yield. (auth)

15715 (KAPL-M-CWS-1) DESIGN AND PERFORMANCE OF D1G STEAM GENERATORS. Charles W. Sorenson (Knolls Atomic Power Lab., Schenectady, N. Y.). June 28, 1957. 19p.

The steady-state heat transfer relationship is treated in steam generators transferring heat from the primary coolant of a water-cooled reactor plant to boiling water. Specific heat transfer relations are derived between primary coolant temperature and flow, steam temperature, steam generator heat transfer resistances, and boiler tube length. Primary coolant pressure drops and steam generator dimensions for vertical generator proposed for D1G are also considered. (D.L.C.)

15716 (NP-9952) GASES AS SECONDARY HEAT TRANSFER FLUIDS. J. S. Doolittle, W. O. Doggett, and C. F. Martin (North Carolina State Coll., Raleigh). Oct. 1960. Contract Nonr-486(03). 48p.

The relative effects of the use of hydrogen are presented for the secondary heat exchanger, the transfer piping, and the air radiator. In general, by a change in the configuration of the component parts, it is possible when using hydrogen to reduce weights to values comparable with those required for the liquid alkali metals. Gas pressures must be in the order of several thousand psi and pumping powers used which are several times those for the liquid alkali metals. Similarly, by using larger parts whose weights are several times those required for the alkali liquid metals, the pumping horsepowers may be reduced to values similar to those for the liquid alkali metals. Hydrogen at pressures of 1,000 psi is superior from the weight-pumping power requirements to the heavy liquid metals such as lead-bismuth. When weight is not a prime consideration, hydrogen shows considerable promise as a secondary heat transfer fluid. (auth)

15717 (OOR-1256:13) DEVELOPMENT OF TEMPERATURE PROFILE FOR TURBULENT HEAT EXCHANGE IN A PIPE. Technical Report No. 10. Thomas J. Hanratty and Robert E. Johnk (Illinois. Univ., Urbana. Engineering Experiment Station). Feb. 1961. Contract DA-11-022-ORD-1707. 141p.

Data on radial temperature distribution were obtained in the thermal entrance region of a fully developed turbulent flow of air in a pipe. Uniform wall heat flux was employed

in the heat transfer section, which was long enough to allow the temperature profile to become fully developed. The data are used to examine the validity of analytical approaches to the problem which are based on an analogy between heat and momentum transfer. Empirical expressions describing fully developed and entrance region temperature profiles were obtained. The entry region data show that the temperature profiles close to the wall attain their fully developed shape rapidly after the flow enters the heat transfer section. Eddy diffusivity profiles calculated in the entrance region vary with distance downstream from the entrance, indicating an effect of time dependency of the turbulent diffusion process. (auth)

15718 (TID-6689) BASIC EXPERIMENTAL STUDIES ON BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES FOR MONTH OF SEPTEMBER 1960. Monthly Progress Report. (Columbia Univ., New York. Engineering Research Labs.). Sept. 30, 1960. 33p. (MPR-X-9-60).

Studies of heat transfer and hydraulics with forced flow boiling water at high pressure are reported. Current emphasis is placed on obtaining data and operating experience with full scale simulations of representative portions of currently proposed fuel element geometries. Studies will also be made using simple test sections to obtain an improved understanding of how heater tube failure is approached. (W.L.H.)

15719 (TID-7592) SYMPOSIUM ON PARTICLE-FLUID INTERACTIONS. Held at the New York Operations Office, AEC, May 1959. (New York Operations Office, AEC). November 1960. 97p.

Thirteen papers are included; separate abstracts have been prepared for ten. (W.L.H.)

15720 (TID-7592(p.56)) FLUIDIZED-BED STUDIES AT ARGONNE. D. Miller (Argonne National Lab., Ill.).

A description is given of several programs for investigating particle-fluid interactions, their application in studying reactor concepts, and their utilization in uranium feed-materials preparation, fuel reprocessing, and waste disposal. (W.L.H.)

15721 (TID-7592(p.72-8)) CREEPING VISCOUS FLOW AROUND ASSEMBLIES OF PARTICLES. J. Happel (New York Univ., New York).

An investigation was made to determine the nature of hydrodynamic interactions in which particles gradually increase in concentration in an assemblage and to arrive at this objective from a fundamental mathematical viewpoint. (W.L.H.)

15722 (TID-7592(p.79-93)) EFFECT OF SOLIDS ON TURBULENCE IN A FLUID. T. J. Hanratty and Hisao Kada (Illinois. Univ., Urbana).

The effect of solid particles on fluid turbulence was studied for fully developed flows of slurries in a vertical 3-in. pipe. Point-source turbulent-diffusion data in the slurry flows were compared with data for flows without solids present. The solids do not appear to affect the diffusion rate unless there is an appreciable average slip velocity between the solids and the fluid. (auth)

15723 (TID-11928) QUARTERLY PROGRESS REPORT TO JOINT U. S.-EURATOM RESEARCH AND DEVELOPMENT BOARD ON BATTELLE ASSISTANCE TO AEC-EURATOM PROGRAM FOR THE PERIOD ENDING DECEMBER 31, 1960. Harold M. Epstein and Donald L. Keller (Battelle Memorial Inst., Columbus, Ohio). Contract W-7405-eng-92. 13p.

Summaries are included of work performed on heat-transfer and void-distribution relations in forced-convection subcooled-boiling water, and on the development of uranium nitride as a reactor fuel material. (B.O.G.)

15724 (TID-12092) RESULTS OF WET STEAM COOLING EXPERIMENTS. PRESSURE DROP, HEAT TRANSFER AND BURNOUT MEASUREMENTS WITH ROUND TUBES. L. Berkowitz, S. Bertoletti, J. Lesage, G. Peterlongo, G. Soldaini, and R. Zavattarelli (Centro Informazioni Studi Esperienze, Milan). Oct. 1960. 245p. (CISE-R-27).

Data obtained with the Piacenza heat transfer facility are reported for pressure drop, heat transfer, and burnout in two-phase steam—water in round tubes. A computer was used to calculate quantities of interest from the experimental data. (D.L.C.)

15725 (TID-12262) FORCED CONVECTION LIQUID METAL INPILE LOOP HELIUM PRESSURE CALCULATIONS. A. Tarasewich (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Apr. 23, 1959. 11p. (TIM-575)

Calculations are presented for the cold (68°F) helium pressures needed in the upper and lower sections of the Forced-Convection Liquid-Metal In-pile Loop in order to provide the required helium pressure of 150 psig at operating temperatures. (D.L.C.)

15726 (TID-12267) FORCED CONVECTION INPILE LOOP AIR COOLING SYSTEM PRESSURE DROP CALCULATIONS. C. W. Johnson, Jr., D. B. Vassallo, and C. Ferguson (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). May 20, 1959. 61p. (TIM-484)

Computations are presented for the air pressure drop and flow occurring in the air cooling system used in conjunction with the ETR process water to cool the Forced-Convection Liquid-Metal In-Pile Loop. (D.L.C.)

15727 (TID-12270) ONE DIMENSIONAL APPROXIMATIONS TO THE EFFICIENCY OF BI-METALLIC CIRCULAR FINS. P. G. Kvick and G. F. Turner (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Feb. 27, 1959. 26p. (TIM-599)

In order to predict the thermal efficiency of high-conductivity metal fins clad with protective low-conductivity metal, temperature distributions were determined in a variety of circular bimetallic fins of rectangular profile. The distributions were obtained using a variable resistance analog to simulate fin and air film characteristics. The assumptions involved are discussed. (D.L.C.)

15728 (TID-12273) HEAT EXCHANGER TUBE SPACER DEVELOPMENT WATER TEST. Lee K. Knudsen (Pratt and Whitney Aircraft Div., United Aircraft Corp., [Hartford, Conn.]). Oct. 16, 1957. 31p. (TIM-412)

Heat exchanger tube spacers were examined on the basis of their fabricability and resistance to water flow. For current liquid metal heat exchangers, strut spacers are recommended because of their ease of fabrication and superior tube bundle support. This spacer gives exact tube location, no critical welds, and no tube-to-tube tolerances. Tube insert spacers offer the least resistance to flow of all spacers (rings, spirals, and struts) tested, but presented critical tube-to-spacer welds. Total pressure losses in triangular pitch heat exchangers require calculation of pure frictional losses and spacer losses. (auth)

15729 HEAT EXCHANGE IN THE LAMINAR AND TRANSITION REGIONS OF A LIQUID METAL FLOW. B. S. Petukhov and A. Ya. Yushin (Moscow Inst. of Power Engineering). Doklady Akad. Nauk S.S.S.R., 136: 1321-4 (Feb. 21, 1961). (In Russian)

Experimental studies were made of heat transfer in the laminar and transition regions of forced mercury flow in an annular tube with constant thermal flux density at the walls. The hydrodynamics and thermal stabilization of the flow were analyzed. The scheme of the experimental installation is included. (R.V.J.)

15730 THE IMPROVEMENT OF FUEL ELEMENT HEAT TRANSFER BY SURFACE ROUGHENING. V. Walker (United Kingdom Atomic Energy Authority. Development and Engineering Group, Windscale, Cumb., Eng.). Nuclear Eng., 6: 144-8(Apr. 1961).

Heat transfer characteristics were studied for Be, stainless steel, and other high temperature fuel element canning materials. The relative merits of using finned fuel elements or of using roughened surfaces on fuel elements are discussed. The heat transfer and friction properties for surfaces having various sizes and shapes of roughness are investigated, and the potential applications of these surfaces in high-rated gas-cooled reactor fuel elements are examined. (T.F.H.)

15731 UPSTREAM DIFFUSION IN HAGEN-POISEUILLE FLOW. T. O. Passell and C. L. Perry (Stanford Research Inst., Menlo Park, Calif.). Phys. Fluids, 4: 444-7(Apr. 1961).

A theoretical study is described for steady state diffusion of a contaminant from a large reservoir of static fluid into a cylindrical tube discharging fluid into the reservoir. Contaminant decay is considered. Numerical results are presented for the rate of decrease along the tube of the concentration of contaminant for Reynolds × Schmidt numbers >10 and either small or zero decay. The method used explicitly exhibits quantities of physical interest including a simple form for the asymptotic solution. These results are of practical use in estimating the contamination in the tube at points that are relatively close to the mouth of the tube. An estimate is made of the distance from the tube mouth at which the asymptotic solution given becomes valid. Used for the prediction of heat flow, the results are valid for Péclet numbers >10. (auth)

15732 EQUIPMENT AND PROGRAMME FOR RESEARCH ON HEAT-TRANSFER IN PRESSURIZED WATER REACTORS. C. Arneodo. Termotecnica (Milan), 15: 135-42(Mar. 1961). (In Italian)

The work of several specialists on heat transfer is described, and results are given. It is shown, however, that experiments have not yet been done above 140 kg/cm^2 (2000 psi), and the Politecnico in Turin, Italy, has built a test loop for pressures up to 225 kg/cm^2 (3200 psi). At this pressure, the differences in the specific gravity and in the other thermodynamic properties of water and steam disappear, and, therefore, their heat transfer properties should be equivalent so that burn-out could be easily studied. It is found that with forced flow burn-out occurs always at the end of the stainless steel test tube, whereas with natural flow it can also occur in the first half of the tube. High-speed photography is used to record nucleate boiling phenomena. (EURATOM)

Instrumentation

15733 (AD-246158) DEVELOPMENT AND TESTS OF A RADIOACTIVE SEDIMENT DENSITY PROBE. Technical Memorandum No. 121. Joseph M. Caldwell (Office of the Chief of Engineers. Beach Erosion Board, Washington, D. C.). Sept. 1960. 47p.

The development, calibration, and laboratory and field testing of an instrument for in-place determination of sediment density are described. The device, encased in a submersible probe and utilizing 3 millicuries of Ra^{226} as a source of radioactivity and 3 halogen-filled Geiger-Mueller counters to detect reflected gamma rays, transmits a preamplified signal through a 75-foot cable to a scaler, the signal being correlated to the density of the sediment-fluid mixture. The probe senses the in-place bulk density of sediment surrounding the probe over a sphere of material of about 1-foot radius centered on the probe. Evidence is presented that this device is an accurate and practical tool for use in the field and that its accuracy is greater and costs less than for other methods presently in use. (auth)

15734 (AERE-R-3521) A DEVICE FOR THE SYNCHRONISATION OF TWO DROPPING MERCURY ELECTRODES. W. H. Lockwood (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Dec. 1960. 7p.

Constructional details are given of a mechanism which effects the simultaneous detachment of the mercury drops from two dropping mercury electrodes. Theoretical considerations of the design are presented. (auth)

15735 (AERE-R-3532) A REMOTE READING GAMMA DOSE-RATE METER AND A TRAINING INSTRUMENT FOR CIVIL DEFENCE. K. E. G. Perry and J. E. Maddock (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Dec. 1960. 22p.

Two instruments are described which were designed for Civil Defense use. The Remote Reading Dose-rate Meter Type 1532, battery-operated, is to be used in an underground shelter to give an indication of the level of gamma radiation existing above ground due to fall-out from atomic weapons and measures dose rate over the range of 0.1 to 500 r/hr. The second instrument, Trainer Type 1532, was designed for training purposes to simulate the type of response which would be obtained from the Remote Reading Dose-rate Meter under radioactive fall-out conditions. (auth)

15736 (AFCRL-TN-60-653) THEORETICAL AND EXPERIMENTAL INVESTIGATION OF RADIOACTIVE IONIZATION GAUGES (thesis). Scientific Report No. HS-1. Mohammad A. El-Moslimany (Michigan. Univ., Ann Arbor. Coll. of Engineering). May 1960. Contracts AF19(604)-545, 1511, 1948, 6162. 183p. (AD-243523)

The merits of rocket-borne radioactive ionization gages in measuring densities and temperatures at high altitudes are discussed. A systematic study was made of the properties and behavior of these gages. The chief ionic and electronic processes encountered are reviewed. A relationship between the collected ion current and the gas pressure was analytically developed for a planar configuration, considering probability of electron attachment as a function of the electric field intensity and the gas pressure. In calculating the theoretical current pressure curves, the numerical values used for ionic mobilities and the recombination coefficient were those derived from kinetic theory. Bloch and Bradbury's theoretical values of electron attachment were used for different mixtures of nitrogen and oxygen. Experimental current-pressure curves were found to be in fair agreement with the theoretical results. It was found that the hysteresis phenomenon, sometimes exhibited by ionization gages, may be caused by temperature dependence of the main electronic processes inside the gage and by variation in the environmental conditions. It is shown that the primary ionization by α particles, in a gas of constant density, increases as the temperature decreases. Two radioactive ionization gages were designed; one uses α particles emitted

from a radium source and the other employs β particles from a tritium source. The general agreement of the theoretical and experimental current-pressure curves pointed to the validity of Bloch and Bradbury's theory of electron attachment in diatomic molecules. It was found that the planar gage used would be a useful tool in the study of ionization of gases by electron collisions. (auth)

15737 (AFOSR-286) SPECTROSCOPIC METHODS OF TEMPERATURE MEASUREMENTS. Technical Report No. 1. S. S. Penner (California Inst. of Tech., Pasadena. Guggenheim Jet Propulsion Center). Mar. 1961. Contract AF49(638)-984. 39p.

Spectroscopic methods for temperature measurements are described with reference to techniques that can be used if observation times are of the order of a millisecond or less. The techniques are of interest in connection with current studies on shock fronts and plasmas. Recently developed procedures for reconstructing temperature profiles in systems with axial symmetry are described. (auth)

15738 (AFOSR-TN-60-1462) COUNTER ADAPTOR AND FURNACE FOR WEISSENBERG CAMERA. Technical Note No. I. R. A. Young (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Oct. 1960. Contract AF49(638)-624. 36p.

A rugged and versatile counter-adaptor for a Weissenberg camera is described. It has performed well in two years of daily use which included collection of intensity as a function of temperature data with conventional cold stream techniques. Advantage was taken of the adaptor design to mount, directly on the Weissenberg base, a furnace device which blows hot air along the crystal mounting axis. Crystal temperature may be held constant or easily varied over the range up to about 700°C, with no obstruction of the x-ray beams and no readjustment of the furnace position, while the entire zero layer and close-in upper layers are explored. (auth)

15739 (AFSWC-TR-60-60(II)) PASSIVE INSTRUMENTATION; DASA PROJECTS 823 AND 833.4. VOLUME II. Norman F. Harmon (American Science and Engineering, Inc., Cambridge, Mass.). Nov. 1960. Contract AF 29(601)-2322. 463p.

Selected physical constants are given for Li, Be, B, C, Al, Fe, Ni, Cu, Zn, Sn, Pt, Au, and Pb. The relations between the transient physical state of a plastic, the temperature, and the heat absorbed at a constant pressure were estimated for polystyrene, nylon 66, Mylar, phenolic resins, epoxy resins, and polyethylene. Mass absorption coefficients and energy deposition curves for radiation from Planckian sources of seven different energies are given for all 18 materials. (M.C.G.)

15740 (ANL-6288(p.6-9)) SCINTILLATION ION DETECTOR. Sol Wexler (Argonne National Lab., Ill.).

The detector was constructed for use in the mass spectrometer for radioactive gases. The 6-kev ion beam, after passing through the detector slit of the spectrometer, enters the detector chamber through a large slot (1 in. $\times$ $\frac{1}{2}$ in.) which serves to isolate the electric field in the chamber and acts as a pumping port for the compartment. The positive ions of the beam are drawn to an aluminum probe held at a negative potential of 35-40 kv. Each ion striking the surface of the probe causes the release of several secondary electrons, which are accelerated toward a hemispherical scintillating plastic. The latter is covered by a thin coat of aluminum (about 0.03 μ thick) which serves to ground the scintillator electrically and to reflect light toward a commercial photomultiplier on the external side of the plastic. Good optical contact between plastic and photomultiplier is made with a thin film of Dow silicon grease. The multiplier is shielded from stray magnetic fields by Mu-Metal. A very high polish is placed on all internal surfaces (particularly on the probe surface) to avoid electrical breakdown of the very high voltage on the probe. A circular ridge 0.015 in. high, which is pressed into the plastic by a flange bolted onto the system, is an effective vacuum seal for the scintillator. The electron multiplier is operated with the photocathode grounded and the anode at high positive potential. The signal pulses are brought through a 0.001 μf coupling condenser to a cathode follower and then to an amplifier. The amplified pulses are fed to a single-channel analyzer with discriminator, the output of which is both counted directly by a scaling circuit and transformed by a counting-rate meter for presentation on a moving-chart recorder. (auth)

15741 (ANL-6318) MONTE CARLO CALCULATION OF THE ENERGY LOSS SPECTRA FOR GAMMA RAYS IN SODIUM IODIDE AND CESIUM IODIDE. W. F. Miller and William J. Snow (Argonne National Lab., Ill.). Feb. 1961. Contract W-31-109-eng-38.

The energy loss spectra for gamma rays in NaI and CsI crystals were calculated by the Monte Carlo method. The calculations were carried out for point sources, broad and collimated parallel beams, and disc sources of monoenergetic gamma rays varying in energy from 0.142 to 14.0 Mev. The crystals considered were right circular cylinders, varying from small crystals of height and diameter of 0.5 inch to large crystals of height 12 inches and diameter 9 inches, and a sphere of 1-inch radius. Also calculated simultaneously with the energy loss spectra were the efficiencies and total absorption fractions. (auth)

15742 (ARF-1167-9) FEASIBILITY STUDY OF A NEW MASS FLOW SYSTEM. Quarterly Report No. 3 covering Period December 1, 1960 to February 28, 1961. G. M. Burgwald (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Mar. 20, 1961. Contract AT(11-1)-578. Project Agreement No. 5. 28p.

A mass flow measurement technique was devised which meets many requirements for mass flow measurement systems. In this technique, fluid is made to pass through a pivoted S-shaped tube, which tends to rotate due to the angular momentum of the fluid. A torque motor and torsion spring maintain zero displacement, the restoring force being a measure of the angular momentum, and density is measured by absorption of radiation passing through a window in the S tube. From the measured angular momentum and density, the mass flow can be computed. Two experimental mass gages using this technique have been constructed. (D.L.C.)

15743 (ARF-3187-3) ELECTROSTATIC CLASSIFICATION OF SUBMICRON AIRBORNE PARTICLES. Progress Report [for] February 15 to April 15, 1961. G. Langer (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Contract AT(11-1)-578. 6p.

Progress is reported in a study of the basic variables that affect electrostatic classification of heterogeneous aerosols of submicron size, especially below 0.1 micron. The variables of interest are particle size, concentration, composition, shape, and initial charge. Emphasis was placed on studying and controlling initial charge. A new technique was developed for collecting light and electron microscope samples. Further improvements of the charging device were studied. (C.H.)

15744 (BM-RI-5739) FLUORESCENT X-RAY SPECTROGRAPH FOR DYNAMIC SELECTIVE OXIDATION RATE STUDIES: DESIGN AND PRINCIPLES. William J. Campbell and Melvin Leon (Bureau of Mines, College Park, Md.). July 1960. 21p.

A discussion is given of the design and operation of a gh-temperature x-ray spectrograph built to study dymic rates of selective oxidation in molten metals. Calulations were made for the intensities of As $K\beta_1$ and Pb η lines for several arsenic concentrations and an illustrative comparison was made of the results with experiental results. Studies were made of the Sb–Pb system or possible applications of the method to trace analysis. B.O.G.)

15745 (CEA-1676) ENSEMBLE DE MESURE D'ACTIVITE β ET γ PAR CHAMBRE D'IONISATION. (Units for Ionisation Chamber Measurements of β and γ Activity). J. J. Engelmann and H. Roquefort (France. Commissariat à l'Energie Atomique. Centre d'Etude Nucléaires, Saclay). 1960. 9p.

Methods for ionization chamber measurements of β and γ activity are discussed and ionization chambers associated with continuous current amplifiers are described. One type, CP β γ 1, is intended chiefly for measuring the specific activity of β-emitting solutions and the dose rate on the surface of radioactive application systems. A second type, CCPγ 1, serves mainly for measuring the activity of γ-emitting sources or solutions. (auth)

15746 (CEA-1757) DISPOSITIF AUTOMATIQUE ASSURANT LE REMPLISSAGE DE PIEGES EN AZOTE LIQUIDE A INTERVALLES DE TEMPS CONSTANT. (An Automatic Device for Refilling Liquid Nitrogen Traps at Constant Time Intervals). R. Bourguillot and P. Lohez (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). Sept. 27, 1960. 12p.

A study was made of the design of an automatic device for filling liquid-nitrogen traps at constant time intervals in connection with the maintenance of a type MS-5 mass spectrometer; in the tube of the apparatus it is necessary to maintain a vacuum of about 10^{-7} mm of mercury. The replenishing is done every four hours. The presence in the vacuum section of an electron multiplier has led to providing a safety-device making it impossible for mercury vapor to come into contact with either the copper tube or the multiplier in the event of an incident leading to the warming of the traps. In case of a breakdown, the vacuum section is brought to atmospheric pressure by introducing nitrogen. (auth)

15747 (CF-61-3-101) CANE SEQUENCED SAMPLER FOR PROJECT GNOME: DESIGN PROPOSAL. J. W. Landry (Oak Ridge National Lab., Tenn.). Mar. 15, 1961. 19p.

A design is proposed for sampling apparatus to draw a sequence of samples from a filtered gas stream from a contained explosion. Seven sampling vessels, 13 explosion-operated valves, an electronic timer which sequences the value operation, a multichannel fast-response pressure recorder which records sample arrival data, and a stand which is supported on either a concrete pad or associated sampling equipment at the project site make up the sampler. The vessel and piping arrangement is radial, as a cone, with respect to the sample supply point. (M.C.G.)

15748 (CREL-997) AN AUTOMATIC URANIUM FLUORIMETER. J. Leng (Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.). Jan. 1961. 42p. (AECL-1178)

The system was designed to automate a standard uranium fluorimeter. An account of the mechanical and electrical design is given together with circuit descriptions. (auth)

15749 (DESY-A2.72) A 3 BeV/C SPECTROMETER WITH A SLOPED WINDOW IN THE p-θ-PLANE (PRELIMINARY DESIGN). W. Kern and K. Steffen (Deutsches Elektronen-Synchrotron, Hamburg). Jan. 4, 1961. 15p.

Parameters, apertures, and focusing properties of a 3-Bev/c spectrometer with a sloped window in the p-θ-plane are discussed. The acceptances of the system for $\Delta p/p = 0$ in the horizontal and vertical directions are coupled and cannot be computed independently. The effect of the deflecting magnet is a constant vertical shift of all x,x'-phase points in the center of the magnet. The resolution of the magnet is therefore inversely proportional to the divergence of the beam. A total width of 30 cm is required for the counter array in order to cover the full acceptance parallelogram in the x,x'-plane. A liquid hydrogen target which is transversally wider than the well collimated primary beam is suggested so that the spectrometer itself can select the effective target volume. (M.C.G.)

15750 (DLCS-2430105) PERIODIC INTERCALIBRATION OF TEMPERATURE SENSING ELEMENTS. CORE I, SEED 2. Test Results T-641303B. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 31, 1961. Contract AT(11-1)-292. 49p.

Calibration testing was conducted to determine the direction and magnitude of drift in core thermocouples, primary loop and pressurizer resistance thermometers, and the resistance thermometers in the secondary side of the boilers. Because of operational conditions, only those sensing elements in coolant loops A and C could be evaluated. An analysis of data from A and C loops is included. (J.R.D.)

15751 (DP-472) AN EMERGENCY NEUTRON DOSIMETER. John E. Hoy (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Sept. 1960. Contract AT(07-2)-1. 29p.

A small, low cost criticality monitoring device was designed to measure the neutron and gamma exposures that might be received by personnel involved in a nuclear incident or an accidental excursion. Test exposures indicated that the device is suitable for measuring neutron exposures above 1 rad and gamma exposures above 50 r. (auth)

15752 (JAERI-1015) DISCRIMINATION OF NEUTRONS FROM GAMMA RAYS IN THE SCINTILLATION COUNTER. Report No. 15. Takayoshi Fuse (Japan Atomic Energy Research Inst., Tokyo). 1961. 7p.

Research related to the optimum conditions for the discrimination of neutrons from gamma rays is reported. Several types of photomultipliers were used and the degree of discrimination was found to depend on the type of photomultiplier. A clue for the mechanism of the scintillation in anthracene is also suggested, that is, there may be a little difference between the spectra of fast and slow components of the light of scintillation, both of which are distributed around 4,000 A. (auth)

15753 (KAPL-M-GDH-4) A MINATURE U^{238} FISSION COUNTER. G. D. Hickman (Knolls Atomic Power Lab., Schenectady, N. Y.). Jan. 24, 1961. Contract W-31-109-Eng-52. 55p.

A small, 0.25-in. diam. × 0.50-in. long, fast neutron fission counter probe employing highly depleted uranium as the fission material was developed. The isotopic analysis of the uranium is as follows: U^{238} (essentially 100%), U^{236} (0.03 ± 0.02 ppm), U^{235} (0.90 ± 0.20 ppm), and U^{234} (0.04 ± 0.02 ppm). The uranium was plated out of solution to a yield of approximately 1.72 mg/cm^2. Detailed measurements of the fast neutron flux in the Flexible Plastic Reactor (10^5 to 10^6 neutrons/cm^2/sec), obtained with the U-238 fission counter, show it to be insensitive to both thermal neutrons, even without a thermal (Cd) shield, and to high-energy (>5.3-Mev) gamma rays. The gamma sensitivity, photofission of the U_3O_8, was checked in the critical assembly by making a fast neutron flux scan with red phosphorus

($\frac{1}{2}$-in. × $\frac{1}{10}$-in.) pellets. Since the (n,p) threshold reaction in phosphorus (~1 Mev) is approximately the same as the (n,f) reaction in U^{238}, the two scans should yield, as is found to be the case, identical results provided there is no appreciable influence of photofission in the U_3O_8. (auth)

15754 (NP-9985) DEVELOPMENT OF HIGH-TEMPERATURE STRAIN GAGES. National Bureau of Standards Monograph No. 26. J. W. Pitts and D. G. Moore (National Bureau of Standards, Washington, D. C.). Mar. 17, 1961. 20p.

A summary is presented of a program aimed at the improvement of high-temperature strain gages of the electrical resistance type. Potential ceramic and metal components were evaluated and a gage was devised that was based on the evaluations. The gage (NBS 5B) was flexible and easy to install; however, it lacked resistance stability at higher temperatures. In an attempt to minimize this deficiency, ceramic cements were developed that showed greater electrical resistivity than was previously observed at 800 to 1,800°F. A technique was devised for increasing the resistance to ground by applying a fired-on ceramic coating to the grid of a specially developed unbacked gage. A study was made of the cause of the erratic response of cemented gages that was not preheated prior to use. There were strong indications that the erratic response was caused mostly by the rapid decrease in resistance that accompanied structural changes in the cement. (auth)

15755 (NP-10043) PRECISION MAGNETIC FLUX DENSITY MEASUREMENTS WITH BISMUTH WIRE. Technical Report No. 3. James B. Carroll and James A. McKee (Illinois. Univ., Urbana. Cyclotron Lab.). May 24, 1958. Contract Nonr 1834(05). 15p.

The method used in making bismuth coils for measurements of a cyclotron magnetic field is outlined. Bismuth wire was chosen for the flux density measurements because it was desirable that the accuracy of the mapping of the magnetic field be of the order of one part in ten thousand. Since the change of the resistance of bismuth with magnetic field is largest at low temperature, it was decided to use liquid nitrogen as the temperature controlling agent. This method permitted continuous rather than point-by-point measurements. (M.C.G.)

15756 (OOR-1715:37) SPECTRAL ANALYSIS COMBINING A BARTLETT WINDOW WITH AN ASSOCIATED INNER WINDOW. Technical Report 40. Thomas H. Wonnacott (Princeton Univ., N. J.). Feb. 1961. Contract DA 36-034-ORD-2297. 15p.

Usual methods of spectrum estimation allow very strong frequencies to affect the spectrum estimates at distant frequencies because the weighting function (spectrum window) cannot be made identically zero over the rejected range of frequencies. To give bounds for this error, a pair of windows, one with positive side lobes (Bartlett), the other with negative side lobes (modified Bartlett), are used simultaneously. In this way the error reduction achieved by detrending and prewhitening an example economic time series is demonstrated. The details of the spectrum windows, and a discussion of confidence limits for the spectrum, are given. A program for the IBM 650 is available. (auth)

15757 (SC-4456(RR)) INTERIM REPORT ON DEVELOPMENT OF DESIGN CRITERIA FOR RELAYS. Covers the Period 1 April to 31 May 1960. (Oklahoma State Univ., Stillwater. School of Electrical Engineering and Sandia Corp., Albuquerque, N. Mex.). Oct. 1960. 72p.

The stability of a relay is defined as that quality of the design and adjustments that results in the least change in the seating time with given changes in any or all of the variables affecting the time. Data are presented in the form of the transient coil current build-up traces, which show the result of operating a relay at three different design points. The magnetic pull in an air gap is determined by the cross-sectional area of the air gap and the magnetic flux density. Since the flux density is determined by the coil ampere turns, increasing the core cross-sectional area will decrease the ampere turns for a given coil power and outside coil dimensions. The conditions necessary for maximum pull for a given coil power and outside dimensions were investigated. A two-coil configuration is considered; however, the results will apply equally well to a single-coil arrangement. An equation is derived for the transit time of a relay. The solution is kept in terms of the parameter h as much as possible. The reason for this stems from the previous work pertaining to pick-up time. There are several assumptions which are necessary in order to obtain a specific relationship for the transit time. These assumptions are not unreasonable yet leave the final equation containing all of the eight primary parameters a relatively simple expression which lends itself to an easy analysis. The problem of combining the relay pick-up time and transit time into one expression is investigated. This is necessary in order to obtain a basis for selecting a design point in terms of h. Only two variables are vigorously analyzed, these being E and R. The method, however, can be extended to the rest of the variables which influences both the pick-up time and the transit time. The designer has a choice of forming the pole pieces such that small air gaps and long contact pusher arms may be used or larger air gaps and shorter contact pusher arms. From the equations developed, which give the pull in terms of coil dimensions, it is possible to determine the most desirable combination of air-gap length and contact pusher arm length. (auth)

15758 (SC-4466(RR)) DEVELOPMENT OF DESIGN CRITERIA FOR RELAYS. Interim Report, February 1 to March 31, 1960. (Oklahoma State Univ., Stillwater. School of Electrical Engineering). Oct. 1960. 58p. For Sandia Corp.

Experimental data were obtained showing the influence of the variables E, R, N, BT, and AG on the armature travel time. The supply voltage is E, the coil circuit resistance R, the coil turns N, the back tension BT, and the air gap AG. An attempt was made to determine, by the use of dimensional analysis and other known facts, a rationalizing factor which would result in the armature travel time as a function of h being represented by one generalized curve. The per unit pick-up current is called h and is equal to the ratio of the pick-up current (i_p) to the steady state current I_{ss}. Two rationalizing factors were determined. The rationalizing factor involving the cube root appears to give the closest fit for the change caused by each of the five variables. Two of the variables N and BT result in a minimum for the armature travel time in the region of 0.4 for the value of h. The theoretical equations governing the operate time of a relay are discussed. Special emphasis is placed on the transit period of the relay since the governing equations for pick-up time were investigated and a satisfactory solution obtained. Several approximate solutions of the transit time are given. Also an exact solution was derived in terms of the electric and magnetic as well as the mechanical power relations during the transit period. (auth)

15759 (TID-11495) MILLIMETER WAVE COMPONENTS. Final Report. Lester L. Bertan (FXR, Inc., Woodside, N. Y.). Apr. 7, 1960. For Univ. of Illinois. Contract AT(11-1)-663. 29p.

A series of 2-millimeter wave components were developed including waveguide and flanges, crystal multiplier,

rystal detector, bolometer, adjustable shorts, VSWR easuring device, frequency meter, tapered transitions, orns, variable phase shifters, mode converter, power di- ders, bends and twists, terminations, and attenuator. ost of the original components were fabricated from tel- rium copper. However the deleterious effects of corro- on proved to be greater than expected. It was found that old plating the tellurium copper resulted in a very stable alue of attenuation. (M.C.G.)

5760 (TID-12130) A STRAIN-GAGE PULSING DE- ICE. John Alford (Texas Univ., Austin. Structural echanics Research Lab.). Jan. 6, 1961. 54p. For andia Corp. Contract AT(29-2)-621. SCDC-2243; MRL-RM-1-61).

The details of the design, construction, and operation of Strain-Gage Pulsing Unit are presented. The unit is used apply a constant voltage of as much as 160 v to a 120- hm strain-gage bridge for a time variable from 50 to 500 sec depending on the power-dissipative characteristics of ne gages. A circuit diagram for balancing the bridge for oth low and high frequencies is described along with a cir- uit to cancel the short period drift or unbalance due to nermal heating of the gages. It was found that a sensitivity f 0.12 millivolts per μ in./in. of strain can be obtained ith a bridge made up of 2 active Tatnall C9-121 ($\frac{1}{8}$-in. age length) gages with a bridge voltage of 160 volts. (auth)

5761 (TID-12435) DETAILED DESIGN OF A FIXED APER ALPHA AIR MONITOR WITH LESS THAN FIFTEEN MINUTES RESPONSE TIME. William O. Gentry and Gar- and B. Seaborn (Oak Ridge Gaseous Diffusion Plant, Tenn.). 1959?] 20p. (NE/148)

The primary health physics problem at the gaseous dif- usion plants where uranium isotopes are separated is that f airborne alpha-emitting uranium dust. A recently devel- ped instrument that provides a rapid alarm if the airborne ranium dust from a release reaches hazardous levels is iscussed. Prior to its development a delay of approxi- mately five hours was required to allow natural atmospheric radioactivity to decay before long-lived alpha emitters from uranium dust could be detected. This recently developed instrument functions on the principle that when airborne dust containing natural atmospheric radon daughters is col- lected, the activity will increase to a quasi-equilibrium value at which time the rate of deposition will be equal to the rate of decay. The uranium dust is then observed as a rapid change from equilibrium conditions. A unique fea- ture of the instrument is the use of a special differentiating circuit to actuate an alarm when the rate of increase of radioactivity exceeds that which can be expected from the diurnal variations in atmospheric radioactivity levels. The development model of this instrument uses a vacuum pump to draw air through a filter paper disc which collects the entrained dust particles. The alpha radiation from the dust is detected with a scintillation detector. The electron cir- cuitry consists of amplifiers and rate circuits which pro- vide monitored outputs proportional to both the level of radioactivity and the rate of change in this level. One cir- cuit utilizes a special very high capacity electrolytic capacitor which was subjected to extensive testing to de- termine that certain leakage requirements can be met. In addition, special attention was paid to the problem of not actuating the alarm on statistical fluctuations. Twelve transistors are used in the circuit. This monitor features small size and simplicity, and economy in fabrication, op- eration, and maintenance not available in other known monitor designs. It provides an alarm within 15 minutes when uranium dust concentrations exceed 2.1×10^{-10} $\mu c/cm^3$ (three and one-half times the maximum permis- sible concentration for a 40-hour per week exposure). Ad- ditionally, it can be used to measure the average weekly uranium dust concentration by the removal of the filter disc and the measurement of its radiation level after an appropriate decay period. (auth)

15762 (TID-12436) A DOSE SENSITIVE RADIATION ALARM INSTRUMENT WITH RATE COMPENSATION. Daryl M. Papke (Oak Ridge Gaseous Diffusion Plant, Tenn.). [1960]. 21p. (NE-149)

The use of dose-sensitive instruments to detect acci- dental critical nuclear reactions offers several advantages over a rate sensitive system when the primary concern is personnel protection in continuous production plants. An instrument capable of near perfect integration during the nuclear excursion, but which is insensitive to normally en- countered radiation, is preferred. A means of continuously compensating for background radiation that is applicable to many instrument configurations is discussed. Compen- sation is obtained by incorporating an element into the instrument circuitry that possesses a current-voltage re- lationship with near infinite slope over a portion of its characteristic. Such an element may be selected to permit practical cancellation of dose rates less than an expected maximum without altering the alarm instrument sensitivity to a prompt critical reaction. Prototype instruments em- bodying this principle are described. (auth)

15763 (WCAP-6045) NUCLEAR MATERIALS CON- TROL SYSTEM (NMCS). PHASE II. EVALUATION OF N-16 MONITORING IN WTR PRIMARY COOLANT FOR MEASURING FLOW AND REACTOR POWER. R. E. Kronk (Westinghouse Electric Corp. Atomic Power Dept., Pitts- burgh). Feb. 28, 1961. Contract AT(30-1)-2176. 73p.

The feasibility of measuring reactor power and coolant flow rate by monitoring the nitrogen-16 activity in the coolant water was established through experiments at the Westinghouse Testing Reactor. When compared to conven- tional instruments for measuring power and flow rate, the coolant activity monitors show deviations of approximately ±15%. Extensive comparisons are made for power levels ranging from 3.4 to 45.5 Mw and for flow rates from 7,000 to 12,350 gpm. Possible reasons for the deviations are discussed. Self-checking features of primary coolant monitoring instruments are also discussed and compared with available data. A limited number of measurements made on the nitrogen-17 coolant activities show results similar to those obtained with nitrogen-16 radiation moni- tors. (auth)

15764 (AEC-tr-4139(p.35-44)) A METHOD OF IN- CREASING ACCURACY OF MEASUREMENT OF INTENSITY OF RADIOACTIVE RADIATION. B. I. Verkhovskii.

The errors of present radiation measuring techniques are pointed out, and a new method is offered which de- creases apparatus errors and avoids some of the defects of the compensation method. This method, the control signal method, consists in applying a constant control flux of radi- ation concurrently with the radiation being measured. The sum signal is then compared with the control signal from the detector to provide automatic calibration. With a con- trol source of about 3 mc, a constant radiation flux striking the phosphor, and variations in the supply voltage of 1200 to 1800 v, the anode current fluctuations of the photomulti- plier were less than 1%. The amplifier had an amplification factor of 200. (T.R.H.)

15765 (AEC-tr-4139(p.45-57)) THEORETICAL FOUNDATIONS OF THE DESIGN OF RADIOACTIVE SELF- COMPENSATING LEVEL GAUGES. G. G. Iordan.

A theoretical treatment is given the problem of designing radiometric level gages with a specified sensitivity threshold. The electronic follow-up drive is not considered. An equation is derived relating sensitivity threshold, radiation intensity, and duration of measurement. Other equations are then derived which give the values of various parameters of the instrument and of the object being measured. (T.R.H.)

15766 (AEC-tr-4139(p.58-68)) THEORETICAL PROBLEMS AND FUNDAMENTALS OF THE DESIGN OF SELF-COMPENSATING RADIOACTIVE LIQUID-DENSITY METERS. K. S. Furman.

The theory involved in designing radiometric liquid-density gages of the beam transmission type is discussed. Various self-compensating arrangements are considered. The basic equation for the instrument is derived, from which the expression for the sensitivity threshold is obtained. (T.R.H.)

15767 (AEC-tr-4139(p.69-78)) ANALYSIS OF OPERATION OF COUNTING-RATE METER WITH A DIODE PUMP. I. M. Taksar and V. A. Yanushkovskii.

A typical count-rate meter wiring diagram is given and analyzed. Equivalent diagrams for the tube input, the anode circuit, and integration circuit are used to arrive at an expression for the instrument. (T.R.H.)

15768 (AEC-tr-4139(p.79-85)) THICKNESS GAUGE FOR ROLLED SHEET STOCK. V. K. Latyshev, Yu. S. Pliskin, L. K. Tatochenko, and A. K. Felinger.

The different types of thickness gages are reviewed to show that the radiometric type is beter for rolled stock steel. An instrument of the dynamic compensation type is described which indicates when the thickness reaches a pre-determined value. The instrument uses two rotating half-disks to allow radiation from the measuring source and the compensating source to pass through the sample alternatively. A block diagram shows how the circuit components are arranged. Laboratory trials have shown that the device can register changes in thickness of 0.2 mm with a total thickness of sheet of 35 mm and a Co^{60} source of 15 curies. (T.R.H.)

15769 (AEC-tr-4139(p.86-92)) OPERATIONAL TRIAL OF MONITORING WITH GAMMA-DENSIMETER PETROLEUM PRODUCTS CONSECUTIVELY CONVEYED THROUGH PIPELINES. A. A. Akhromenkov, Yu. S. Zaslavskii, A. A. Vargin, A. N. Kornilayev, and V. P. Lapin.

A gamma densimeter for monitoring consecutive pumping of petroleum products is described. It operates on the principle of radiation absorption by the medium in the pipe. The sensitivity of the device makes it possible to measure the passage of the mixture through the pipeline with an accuracy of 0.002 to 0.003 g/cc. (T.R.H.)

15770 (AEC-tr-4139(p.93-100)) METHODS OF UTILIZATION OF GAMMA-DENSIMETERS. E. (Ye.) M. Lobanov.

The operating principle of gamma densimeters is reviewed, and the advantages of this type of instrument are pointed out. These considerations are then applied to the design of a gamma densimeter for testing the density of aqueous soil slurries in the conduits of a machine for removing soil by suction. The device can also be used to measure the density of various ore slurries. A block diagram gives the arrangement of the components with respect to each other. Data are given from various tests of the device to show its wide range of application and its accuracy. (T.R.H.)

15771 (AEC-tr-4139(p.101-15)) AUTOMATIC REGULATION OF LIQUID METAL LEVEL IN CRYSTALLIZER DURING CONTINUOUS CASTING WITH ACTION UPON RATE OF INGOT WITHDRAWAL. V. K. Latyshev, V. V. Lyndin, Yu. S. Pliskin, and L. K. Tatochenko.

A study is presented of systems of automatic level regu tion in machines for continuous casting of steel shapes of small diameter and for semi-continuous casting of iron pipe. The first system discussed is an automatic level regulator for the liquid steel in the crystallizer of a continuous casting machine. After a description of the device the RU-2, a calculation is shown for the static conditions o operation. The stability of the system and the quality of regulation are then discussed. The second system is for regulating the liquid iron level in a semi-continuous castir machine for pipe. The instrument used here is a modification of the RU-2 designated the RU-2a. (T.R.H.)

15772 (AEC-tr-4139(p.116-24)) SYSTEM OF AUTOMATIC REGULATION OF LIQUID METAL LEVEL IN CRYSTALLIZER WITH ACTION UPON STOPPER OF VARYING DESIGN. A. N. Valov, V. K. Latyshev, V. V. Lyndin, Yu. S. Pliskin, and L. K. Tatochenko.

Gamma level regulators of the follow-up, intensimeter, and relay types are compared to show that the latter is better because it has no moving parts in the measuring region, and is simple and reliable. Such an instrument is described for regulation of the liquid steel level in the crystallizer of a continuous casting machine. A mathemati cal analysis of the system is offered, and a block diagram and circuit diagram are given. (T.R.H.)

15773 (AEC-tr-4139(p.125-31)) CONTROL AND AUTOMATION OF OPERATION OF PETROLEUM PROCESSING UNITS BY MEANS OF RADIOMETRIC INSTRUMENTS. Yu. S. Zaslavskii, O. A. Zlobin, E. (Ye.) V. Evstigne'ev (Yevstigneyev), A. A. Kadushin, and G. I. Shor.

The ARPU liquid level regulator for the petroleum processing industry is described and discussed. It utilizes two channels so that while maintaining the interface of a two-phase system at a certain level, it can also limit the maximum level of the upper phase. Tests of the ARPU in various columns of a petroleum plant are listed, with more complete descriptions being given of its use in a kerosene water washer and an asphalt distillation column. (T.R.H.)

15774 (AEC-tr-4139(p.132-7)) DETERMINATION OF ASH-CONTENT OF COAL BY MEANS OF RADIOACTIVE ISOTOPES. S. A. Bel'skii and E. (Ye.) M. Lobanov.

Experiments were performed to evaluate the possibility of using radioactive isotopes to determine the ash content of coal. Two methods were used: beta-backscattering using Sr^{90}, and gamma absorption using Tm^{170}. In the former, curves were plotted to show the dependence of the intensity of backscattered beta particles on the ash content. It was found that with an accuracy of the counting system of the order of 0.5 to 1.0%, ash content can be determined with an accuracy of up to 1 or 2%. The gamma absorption method was similarly studied, and the results were about the same. (T.R.H.)

15775 (AEC-tr-4139(p.138-51)) USE OF THE METHOD OF INDUCED RADIOACTIVITY FOR AUTOMATION OF ROCK SEPARATION. A. A. Rudanovskii.

Development of an induced-activity method of separating rock from coal is described. A literature search indicated that Al^{27} would be a suitable isotope for the purpose from the standpoint of nuclear properties and occurrence. To study the effects of other elements present, samples of rock and coal were neutron-irradiated in powder and lump form and induced activity was plotted versus Al content. The experiments showed that the other elements exert no masking effect. A gamma electronic relay device is described which scans and sorts the mined material. A cascade system is

ployed so that the whole mine output does not have to be anned. (T.R.H.)

776 (AEC-tr-4139(p.173-81)) WORK OF THE KRASNYI METALLIST" PLANT ON MANUFACTURING ND INDUSTRIAL UTILIZATION OF GAMMA-RELAYS OR AUTOMATION OF THE COAL INDUSTRY. A. V. nashchinov.

A report is presented of the work of the laboratory in the evelopment of radiometric instruments for automation of oal mining. The instrument was designed for battery peration but comparative studies were made for a-c. The haracteristics of the STS-8 counters were studied, and the peration of the counter under different conditions of power pply was investigated. A gamma electronic relay with a IKU-48 execution relay is described for mining automation pplications. (T.R.H.)

5777 (AEC-tr-4139(p.182-9)) TYPICAL ELECTRONIC NIT FOR AUTOMATIC RADIOACTIVE INSTRUMENTS OF HE RELAY TYPE. A. T. Kundzin', G. I. Lade, I. M. aksar, K. K. Shpor, and V. A. Yanushkovskii.

Three models of a general-purpose radiometric instrument are described, the URAP-1, -2, and -3a. These are elay devices which operate not on radiation intensity but n the presence or absence of radiation. The first model ctuates another device when a small radiation is detected, ne second model assumes a continuous irradiation of the etectors, the third model employs a hysteresis effect upon ctuation to prevent relay oscillation in the control of a luctuating process. Detector assemblies for use with these nstruments are also described. (T.R.H.)

15778 (AEC-tr-4139(p.190-5)) RADIOACTIVE METHOD OF AUTOMATIC REGULATION OF DENSITIES IN THE FOOD INDUSTRY. V. E. Banashek, V. V. Kolando, I. M. Faksar, K. K. Shpor, and V. A. Yanushkovskii.

A radiometric technique is described for transmittal of he readings of a hydrometer. The position of a radioactive nark on the stem of the hydrometer is determined by a URAP-2a instrument. The application of the technique in egulating aqueous alcohol systems and measuring the density of cosmetic liquids is pointed out. (T.R.H.)

15779 (AEC-tr-4139(p.196-206)) AUTOMATIC MIXING AND PROPORTIONING APPARATUS FOR PREPARING MULTIPLE-COMPONENT MIXTURES, BASED ON UTILIZATION OF RADIOACTIVE RADIATIONS. V. E. Banashek, I. V. Gavalov, M. V. Ogilets, and V. A. Yanushkovskii.

A radiometrically controlled proportional mixing system is described. It can mix liquids or suspensions using gravimetric and volumetric proportioning. Radiometric instruments are arranged to read balance scales and measure liquid levels for materials to be added to the stirring tank. Diagrams are given showing the relay-commutation unit for proportioning a four-component mixture and the preparation of a four-component cosmetic liquid. (T.R.H.)

15780 (AEC-tr-4139(p.207-13)) CONCERNING THE USE IN THE COAL INDUSTRY OF SEMICONDUCTOR TRIODES IN AUTOMATION AND MONITORING APPARATUS BASED ON UTILIZATION OF RADIOACTIVE RADIATIONS. E. E. (Ye. Ye.) Rubinovich.

The operations in coal mining and processing which are amenable to control by radiometric means are summarized, and the application of semiconductor triodes to such instruments is discussed. The operations mentioned are stabilization of mining and shaft-sinking machines, rock sorting, slurry density testing, analysis of air for methane, and determination of level of coal and rock. A block diagram used for designing radiometric instruments for these applications is shown. The semiconductor triode connections in such circuits are pointed out, and an example is given. (T.R.H.)

15781 (AEC-tr-4139(p.214-31)) SOME CHARACTERISTICS OF PHOTOELECTRONIC MULTIPLIERS OF THE NEW TYPES AND THE USE OF THESE INSTRUMENTS FOR TECHNICAL REGISTERING OF RADIATIONS. A. A. Arkhangel'skii and G. D. Latyshev.

The operation of various models of photomultipliers in the circuit of a scintillation counter under the conditions of measurement of the current at the photomultiplier output was studied. The tests were conducted in a scintillation gamma-radiograph flaw detector. A table is given of the characteristics of photomultipliers FEU-11, -12, -19, -34, -2B, and -P5. Scintillation gamma radiography of steel is discussed. (T.R.H.)

15782 (AEC-tr-4139(p.250-9)) LOW VOLTAGE HALOGEN-CONTAINING COUNTERS. L. S. Eig.

The operating parameters of low-voltage counters are described for design purposes. A discussion is included of gas discharges in such counters. (T.R.H.)

15783 (AEC-tr-4139(p.260-85)) THE METHOD OF DYNAMIC COMPENSATION IN RADIOACTIVE-INSTRUMENT BUILDING. L. K. Tatochenko.

Several variants of radiometric instruments with dynamic compensation are described. An analysis of the T-1 thickness gage indicator and measurement error is presented. The treatment is mathematical and includes sections on systems with storage of steady signal, system with compensation of steady signal, system with compensation of unsteady signal of measuring half-cycle, and system with reverse dynamic compensation. (T.R.H.)

15784 (AEC-tr-4139(p.295-310)) THE PROSPECTS OF UTILIZATION OF SEMICONDUCTOR PHOTORESISTANCES IN MONITORING OF IONIZING RADIATION. S. V. Svechnikov.

The advantages and disadvantages and applications of semiconductor photoresistances as radiation detectors are pointed out, and an analysis is given of the properties and characteristics of these devices. (T.R.H.)

15785 (AEC-tr-4339) THE KINETICS OF THE PROCESSES OF PHOTOCONDUCTION AND PHOSPHORESCENCE. M. Schön. Translated from p. 282-364 of "Semiconductor Problems" issued by the Committee on Semiconductors of the Association of German Physical Societies, Vol. 4. Freidr. Vieweg und Sohn. Braunschweig, 1958. 91p.

Properties of photoconducting crystal phosphors are examined. It is noted that in excitation of luminescence and photoconduction in such phosphors, charge carrier pairs of opposite sign are created. The photoconduction is proportional to the concentration of freely moving charge carriers. Light is emitted at the recombination of these carriers. A detailed discussion of the phenomena is presented, and a model is offered to aid in understanding qualitatively the effects of light emission and photoconductivity with homogeneous excitation. (J.R.D.)

15786 (JPRS-7886(p.101-4)) METHOD OF MEASURING β-ACTIVITY IN BIOLOGICAL OBJECTS BY MEANS OF A SCINTILLATING GEL. L. G. Shakhidzhanyan, D. G. Fleishman (Fleyshman), V. V. Glazunov, V. G. Lemot'ev (Lemot'yev), and V. P. Nesterov. Translated from Med. Radiol., 5: No. 10, 72-4(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 6146.

15787 (TIL/T-5078) WORKING CHARACTERISTICS OF MASS SPECTROMETERS. R. Taubert. Translated from Erdöl u Köhle, 10: (8), 516-18(1951). 7p. (AD-245269)

A knowledge of the sensitivity, stability, and interference characteristics of a mass spectrometer permits a determination of the effectiveness of the particular instrument and a comparison with other spectrometers. To obtain an information criterion of the sensitivity, the ratio of the number of ions reaching the collector in unit time to the number of molecules fed in was determined. Methods of obtaining the stability of the following values are discussed: the relative spectrum, the relative sensitivity, and the absolute sensitivity. The measurement of methane/n-butane interference is reviewed as it is a satisfactory test for all hydrocarbon analyses. (M.C.G.)

15788 NOTE ON THE EFFECTS DUE TO PULSE-DELAY PHENOMENA IN $CO_2 + CS_2$ G.-M. COUNTERS. W. Moscicki (Inst. of Nuclear Research, Academy of Sciences, Poland). Acta Phys. Polon., 20: 59-65(1961). (In English)

G-M tubes are considered that are filled with $CO_2 - CS_2$ mixtures. A delay is observed between the time of passage of an ionizing particle through such a tube and the time of the associated output pulse. The influence of this delay effect on the measurement of very weak C^{14} sources is considered; an evaluation of the half life of C^{14} is attempted, taking into account the delay effect. (T.F.H.)

15789 AUTOMATIC SCANNING OF PAPER STRIP CHROMATOGRAMS OF I^{131}-LABELED COMPOUNDS. William J. Schindler and Claude Fortier (Methodist Hospital, Houston, Tex. and Baylor Univ., Houston, Tex.). Can. J. Biochem. and Physiol., 39: 629-32(Mar. 1961).

Design features are described for an automatic scanning device for paper radiochromatograms for the simultaneous detection of the β and γ radiations emitted by I^{131}-labeled compounds. Excellent sensitivity and resolution were achieved by means of two lead-shielded, narrow cesium iodide, thallium-activated scintillation crystals facing each other and coupled to phototubes. A recording scanner was used. Peak areas, determined by planimetry, are converted to radioactivity by reference to a standard curve. Good correspondence was observed between the zones of activity evidenced by radioautography and the peaks of the scanning records. (C.H.)

15790 A COUNTER FOR MEASUREMENT OF TRITIUM EXCHANGE IN SOLIDS. O. Sepall, A. R. G. Lang, and S. G. Mason (Pulp and Paper Research Inst. of Canada and McGill Univ., Montreal). Can. J. Chem., 39: 827-34(Apr. 1961).

An apparatus for measuring the exchange of tritium (H^3) between water vapor and solids such as cellulose was developed which is simpler, less expensive, and more precise than an earlier model. Both the exchange reaction and the determination of sample tritium activity are performed in a windowless, proportional counter. The background activity in sorbed water on counter surfaces is measured independently of sample activity. Satisfactory reduction of the effect of the electrostatic charge on the sample upon counting rate is acheived by the geometry of the counter. (auth)

15791 METHOD FOR THE EXPERIMENTAL DETERMINATION OF THE CROSS SECTIONS OF SIMPLE SCATTERING AS A FUNCTION OF THE ATOMIC NUMBER Z IN NUCLEAR EMULSIONS. Madeleine Avan, Jean Faïn, Lionel Hugon, and Pierre-Yves Bertin (Faculté des Sciences, Clermont, France). Compt. rend., 252: 1138-40 (Feb. 20, 1961). (In French)

The conditions for the utilization of targets incorporated in nuclear emulsions and the limits imposed on angular measurements are determined. The measurement of simple scattering is significant, whatever the metal, for angles higher than 10′. (tr-auth)

15792 NEUTRON DETECTORS FOR MEASUREMENT AND CONTROL OF NUCLEAR REACTORS. Agustin Tanarro Sanz (Junta de Energia Nuclear, [Madrid]). Energia nuclear (Madrid), 4: No. 16, 51-60(Oct.-Dec. 1960). (In Spanish)

Neutron detectors are based on the interaction of neutrons with B^{10} and on the fission of U or Pu. The characteristics of these two types of counters are described and compared. Thermometric detectors, also used for neutron detection and measurement, are briefly described. (J.S.R.)

15793 GLASS BORON TRIFLUORIDE PROPORTIONAL COUNTER. H. Fröhlich (Universität, Jena, Ger.). Exptl. Tech. Physik, 8: 241-7(1960). (In German)

The manufacture of a BF_3 counter of boron-free glass with layer cathode was studied. The construction of the tube and the manufacture of the cathode are described. Since the possibility of the formation of electronegative gas constituent particles exists in glass tubes with BF_3 filling, the survival probability of the electrons in the tube must be as large as possible. As impurities from electronegative gases are not considered in the equation for the survival possibility, the preparation and purification of the filling gas and tube must be carefully done. A family of curves was derived for the evaluation of the counter tube. From these curves the pulse rate dependence on the tube voltage, the integral pulse height distribution, and the gas amplification can be obtained. (tr-auth)

15794 THE ROLE OF SEMI-CONDUCTORS IN HIGH ENERGY PHYSICS. Carl M. York (Univ. of California, Los Angeles). Inds. atomiques, 4: Nos. 11/12, 55-60 (1960). (In French)

After a review of the qualities and performances of the transistors used in the electronics of nuclear physics, the different properties of some transistorized circuits, such as emitter-follower, amplifier, multivibrators, and gate circuits, are described. The latest developments in the region of semi-conductors as diode tunnels and junction particle detectors are presented. (tr-auth)

15795 NUCLEAR INSTRUMENTATION IN FAST ELECTRONICS. SCALERS IN FAST ELECTRONICS. Jean-Marie Servent (Electronique Appliquee, Paris). Inds. atomiques, 4: Nos. 11/12, 114-18(1960). (In French)

A brief description is given of the design and characteristics of a fast scaler, inlet gate circuit, automatic recorder of the scaler results, phase-shifting pulse generator, and nanosecond generator. The scaler has a counting capacity of 10^9 counts for a time resolution of less than 0.1 sec. (J.S.R.)

15796 SCALER WITH RESOLUTION TIME EQUAL TO 10 NANOSECONDS. J. Loison (Societe Intertechnique, Versailles, France). Inds. atomiques, 4: Nos. 11/12, 119-20(1960). (In French)

In systems of fast decimal counters, there are three problems to be resolved: to study a bistable having a short switching time, to form with the aid of three bistables a circuit divisible by 5, and to normalize the input pulses. The solutions to these problems for the nanosecond scaler are presented. (J.S.R.)

15797 A POCKET GAMMA-DETECTOR. F. K. Levochkin. Issledovaniya v Oblasti Dizimetrii Ioniziruyushchihk Izluchenii, Sbornik Statei, 121(1957).

A battery pocket gamma-detector for the detection of gamma radiation and the approximate rating of the dose rate with the range from the natural background and up to some

icroroentgen per second is described. Two gas dis-
arge tubes are used as indicators, one of which is put in
ries with the radiation counter, the other at the output of
e RC-filter, connected in parallel to the load resistor of
e counter. The device is calibrated with the aid of the
mma source by compiling a table of relation between the
se rate (in mocroroentgen/second) and the number of
ashes of the neon gas discharge tubes. There is one cir-
it. (auth)

5798 AMPLITUDE ANALYZER OF NUCLEAR RADIATION SPECTRA. V. O. Viazemskii, Yu. M. Kazarinov, nd V. V. Trifonov. Izvest. Leningrad. Elektrotekh. Inst., o. 38, 237-48(1959).

The limitations and advantages of using various memory evices in amplitude analyzers are investigated. A description is given of the "AMA-3c" (AMA-3s) type automated multi-channel amplitude analyzer with an electrostatic storage tube as memory device. It possesses the llowing characteristics: number of channels—128; apacity of each channel—2^{16}, resolving time 0.5 + 22 μsec = channel number). The results are read on the monitor creen in the form of binary numbers or as histogram. The nalyzer can operate with external control pulses (under oincidence or anticoincidence conditions). The number of ubes is 130, power consumption is 850 w. (auth)

5799 DESCRIPTION OF A LOW PRESSURE ADORPTION APPARATUS. Yves Larher (Centre d'Etudes Nucléaires, Saclay, France). J. chim. phys., 1107-8 1960). (CEA-1667). (In French)

The need to measure specific surface areas of graphite ed to the construction of a krypton adsorption apparatus; he conventional MacLeod gage for pressure measurements s modified so as to be more suitable for this particular se. (auth)

5800 A SMALL-ANGLE X-RAY SCATTERING APARATUS USING A SPHERICALLY BENT CRYSTAL. . Hagström and K. Siegbahn (Univ. of Uppsala). J. Ultrastructure Research, 3: 401-19(1960). (AFOSR-526)

A new method is described for curving a circular quartz amina to give a point-focusing monochromator for x-rays. This monochromator is used in an apparatus for studying small-angle scattering of x-rays. The distance between the scattering specimen and the focus can be varied continuously, the maximum distance being 850 mm. The recording of the scattered intensity can be made either photographically or by means of annular slits in front of a counter tube. The instrument is characterized by exceedingly high resolving power and good intensity. Applications are made on the study of polystyrene latex of three different particle sizes with the following diameters: 3400 A, 2640 A, and 1340 A. The secondary maxima in intensity which appear from scattering spheres are very well resolved in all azimuths even for the largest particles. Exposures of collagen from kangaroo tail tendon are taken. The diffraction pattern from a periodicity of 637 A in this specimen shows that the different diffraction orders are very well separated. The camera is capable of resolving consecutive orders of spacings as high as 8000 A. (auth)

15801 LOW VOLTAGE COUNTER AND ITS TENDENCY TO SECONDARY DISCHARGES. R. Höhle (Institut für Angewandte Radioaktivität, Leipzig) and P. Kunze. Kernenergie, 3: 1154-64(Dec. 1960). (In German)

Counters without quenching vapor additions and filled with helium or neon and with a low argon admixture work at 100 to 200 v, in which the quenching is done by a pulse of variable length. With decreasing extinction time the reignition probability increases exponentially. This behavior was quantitatively explained as temporal decay of the concentration of metable rare gas atoms which arise simultaneously with ion pairs in the counting pulse. (tr-auth)

15802 THE SO-CALLED "RADIUS EFFECT" IN BF_3 COUNTERS. H. F. Brinckmann (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 3: 1165-8(Dec. 1960). (In German)

The acoustic sensitivity of BF_3 counters and its dependence on the site of the primary ionization was tested by two completely independent methods. In the first method the counter was passed through a narrow collimated neutron beam parallel to the axis, and the pulse-rate dependence on the distance of the beam from the counter was measured. In the second method the delay time between the detection reaction $B^{10}(n,\alpha)Li^7$ and the initial pulse in the counter wire was measured and the experimentally determined value for the maximum delay was compared with the theoretical value. In both cases a uniform effectivity was found over the complete diameter of the counter, in opposition to the experiments of Milojewic. (tr-auth)

15803 THE MEASUREMENT OF THE DECAY TIME OF ORGANIC SCINTILLATORS. R. Reichel (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 3: 1172-6(Dec. 1960). (In German)

A device for measuring the decay time of organic scintillators, based on the principle of Elliot, Liebson et al., (Phys. Rev., 80: 907(1950)), is described. Its design and performance are discussed in some detail. (J.S.R.)

15804 A MAGNETIC MASS SEPARATOR WITH SMALL MAGNET FIELD VOLUME. M. von Ardenne (Forschungsinstitut Manfred von Ardenne, Dresden-Weisser Hirsch, Ger.), G. Jäger, F. Köhler, and G. Petter. Kernenergie, 3: 1177-91(Dec. 1960). (In German)

A magnetic mass separator for high mass transport with magnet weight reduced to 20 tons and a pump plant with suction powers reduced to 2000 l/sec is described with respect to beam path, construction, and performance. The weight of the separation magnets could be reduced from about 200 tons in the classical large plant to 20 tons without essential lessening of the mass transport by utilizing a new type of optical beam path. The beam path used is such that appropriate plasma column curvature and ion source optics causes a cross-over in the 60° separation magnetic field. A glowing cathode vapor discharge source with axial auxiliary magnetic field, artificially produced cathode potential drop, lateral exhaust, and special construction is used as ion source. Through the special construction, additional heating of the evaporation furnace through energy supply from the ion source discharge and from reflux parasite electron currents is avoided so that a very stable operation is obtained in loading the source with easily vaporable materials. By lowering the vapor pressure in the radiation space, gas evolution from oil vapor cracking was greatly reduced. Therefore it was possible to reduce the evacuation plant to a suction power of only 2000 l/sec and to guarantee a working pressure of only 1 to 1.5×10^{-5} torr. With a magnesium source and 40 kv acceleration voltage, an ion current of 100 mamp was obtained. Because of the favorable beam path and the low pressure approximately 80% of the beam was collected in the trap. (tr-auth)

15805 A DISTANCE CORRECTION FOR MEASUREMENTS ON RADIOACTIVE PREPARATIONS BY MEANS OF AIR-EQUIVALENT SPHERICAL CHAMBER. K. Willuhn (Deutsche Amt für Mass und Gewicht, Berlin). Kernenergie, 4: 19-21(Jan. 1961). (In German)

It was shown that in measurements on radioactive preparations with spherical ionization chambers at a preparation distance which is comparable with the chamber dimension, the finite expansion of the chamber must be considered by introduction of a corrected distance. A general expression for the magnitude of this correction is given and numerically evaluated for chambers of various dimensions. A comfirmation was experimentally obtained. (tr-auth)

15806 BORON-CONTAINING IONIZATION CHAMBERS FOR THE DETERMINATION OF NEUTRON ABSORPTION CROSS SECTIONS. J. Beck (AEG-Studiengruppe EL, Munich). Kerntechnik, 3: 81-2(Feb. 1961). (In German)

The construction and properties of a boron-containing ionization chamber are described. With this chamber the neutron absorption cross sections of materials of all kinds can be determined in a reactor. (tr-auth)

15807 SOME PRACTICAL HINTS FOR WORK WITH GEIGER-MUELLER COUNTERS. H. Gebauer (Frieseke & Hoepfner G.m.b.H., Erlangen-Bruck, Ger.). Kerntechnik, 3: 84-6(Feb. 1961). (In German)

With respect to dependable operation with Geiger-Mueller tubes, the essential properties of this type of counter are explained. After a discussion of the plateau properties, the optimum operating voltage is considered. The effect of temperature on the plateau properties is then described. The zero effect and the coupling of G-M tubes to electronic imput circuits are discussed. (tr-auth)

15808 A MEASURING DEVICE INCLUDING AN IONIZATION CHAMBER FOR DETERMINING THE STRENGTH OF γ-ACTIVE PREPARATIONS IN THE RANGE OF 10^{-4} TO 1 CURIE. Csaba Ujhelyi. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen). Közlemények, 2: 237-41(1960). (In Hungarian)

An ionization chamber was connected with a Lauritsen-type electrometer having a gold-plated quartz fiber. The inner wall of the cylinder is formed by Pb-shielded Cu cylinder which was Cu-plated to a thickness of 100 mg/cm^2 in order to eliminate the disturbing effect of an eventual α-contamination. Plexiglass has been used as insulating material. The deflection of the fiber was viewed by a microscope. The inner atmosphere of the chamber was dried by $CaCl_2$. After operating the instrument for more than a year for measuring the activity of preparations including Co^{60}, Cs^{137}, and Ra^{226} the strength of which ranged from 0.01 to 1 Curie it was found that its standard deviation was 0.2 ± 0.1%. (TTT)

15809 AN AUTOMATIC ARRANGEMENT FOR MEASURING ISOTOPES. György Kósa and Tibor Scharbert. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen). Közlemények, 2: 243-7(1960). (In Hungarian)

In order to save time and to eliminate the systematic errors, an automatic measuring device has been developed yielding excellent results in radiobiological studies. It consists primarily of a Pb-shielded chamber containing a GM-tube and an automatic unit for advancing the samples. The automatic unit consists of a record player turntable the timing of which is controlled by a synchronous motor. The counter is provided with a binary scaler. After measuring the activity of the six samples on the turntable, the device stops automatically for reloading. (TTT)

15810 EXAMINATION OF THE CRITICAL RADIUS OF THE BF_3 COUNTER. Gyula Csikai, Erzsébet Molnár, and Bálint Schlenk. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen). Közlemények, 2: 225-8(1960). (In Hungarian)

A. Milojevič et al., (Proceedings of the Second International Conference on the Peaceful Uses of Atomic Energy, Geneva, 1958, 14, 325 P/493) have noticed that the sensitive volume of a BF_3 counter depends on a critical radius which is independent of the actual geometric dimensions of the apparatus. These findings could not be confirmed in experiments performed with a counter which was provided with a mica end window and was filled with BF_3 gas under a pressure of 150 and 300 mm of Hg. A beam of α-particles was introduced into the counter parallel with the anode. The radial variation of the number of pulses and the integral amplitude distribution obtained as a function of the electronic amplification were determined, using various anodic distances. It is postulated that the effect observed by Milojevič and his co-workers was due to the electronegative contamination of the BF_3 gas. (TTT)

15811 TRANSISTORIZED PULSE HEIGHT INDICATOR. U. Galil and D. Ophir (Israel Inst. of Tech., Haifa). Nuovo cimento (10), 17: Suppl. No. 2, 197-201(1960). (In English)

The apparatus described presents a simple method using transistorized circuitry for the numerical indication of data obtained from cosmic ray detectors. The method is applicable to the indication of any pulse height by converting amplitude levels to pulse counts. (auth)

15812 USE OF NUCLEAR EMULSIONS AS AN ANALYSER OF PROTON POLARIZATION: APPLICATION TO THE POLARIZATION OF PROTONS IN THE PHOTODISINTEGRATION OF THE DEUTERON. B. T. Feld, B. C. Maglić, and J. Parks (Massachusetts Inst. of Tech., Cambridge). Nuovo cimento (10), 17: Suppl. No. 2, 241-52(1960). (In English)

The use of nuclear emulsions as an analyzer of proton polarization at an energy of 150 Mev is studied experimentally by two different methods of scanning. An analyzing power of +0.47 ± 0.08 was obtained for scattering angles of 5° + 20°. As an application of the emulsion method, the excitation function was measured for the reaction $\gamma + d \rightarrow n + p$ from 150 to 300 Mev, and the polarization of protons produced by photons of E_γ = (250 ± 40) Mev. The most likely value of the polarization was determined to be $+0.27^{+0.16}_{-0.18}$ at 45° c.m. angle. (auth)

15813 STUDY OF SENSITIVITY VARIATIONS IN IONOGRAPHIC EMULSIONS EXPOSED TO ALPHA PARTICLES AT A TEMPERATURE GREATER THAN 20°. C. Benaut and R. Rechenmann (Centre de Recherches Nucléaires, Strasbourg). Nuovo cimento (10), 17: Suppl. No. 2, 264-70 (1960). (In French)

The sensitivity variations in ionographic emulsions Ilford G-5 and C-2, as a function of the temperature of exposure (20 to 110°C) were determined by total photometric and microphotometric measurements. The sensitivity of G-5 emulsions to alpha particles does not vary significantly with the exposure temperatures at 20 to 90°C if one develops the plates in a strong developer. The densities increase uniformly in a weakly reducing solution of pyrocatechine. Developed in Id-19, the C-2 emulsions become more sensitive to α particles if the exposure temperature is increased for the ID-19. Pyrocatechine shows an increasing sensitivity with temperature. The microscope-photometric measurements done on the C-2 plates developed in ID-19 showed a progressive broadening of α-particle tracks with exposure temperature. (tr-auth)

15814 TRANSISTORIZED NUCLEAR ELECTRONICS AT THE CENTER FOR NUCLEAR STUDIES AT ISPRA. G. Colombo, I. De Lotto, G. Gianelli, V. Mandl, and L. Stanchi (Centro Studi Nucleari, Ispra, Italy). Nuovo cimento (10), 17: Suppl. No. 2, 271-6(1960). (In Italian)

A counting apparatus was studied for telemetering uses. is one is of the digital type and is based on the pulse code odulation system (PCM/AM). The measured quantities e transferred, in binary form, into a memory. From the emory the data are transmitted with a given repetition fac-, using a ring system. So we have, besides a great capac- of information, a large probability of correct reading of e received data. The transmission is obtained with a ansmitter having a power of about 65 Mw and working at 8,03 MHz. (auth)

5815 ENRICHED BORON COUNTER TUBES FOR HERMAL NEUTRONS. Rev. gén. électronique, No. 172, (Mar. 1961). (In French)

The tubes consist essentially of a cylindrical cathode ade of 0.5 mm high purity copper and a central anode hich is a 0.05 mm molybdenum wire. They are filled with F_3 enriched with B^{10} to increase sensitivity. When a ermal neutron passes through the cathode wall, there is certain probability that it will produce with an atom of F_3 a reaction (n,α). The α radiation and the lithium nu-leus thus created have a total energy of 2.3 Mev and ion-ze some atoms of the gas; the potential difference between node and cathode is chosen in order to obtain a propor-ional response of the counter, and small localized charges re collected by the electrodes. Across a load resistor between 0.5 and 4.10^6 ohms) voltage pulses of the order of 10^{-2} volt can be measured. The influence of β-producing radiation can be eliminated by proper adjustment of the ounter threshold. (EURATOM)

15816 ACTIVE FILTER ELEMENT AND ITS APPLICATION TO A FOURIER COMB. F. T. May and R. A. Dandl (Oak Ridge National Lab., Tenn.). Rev. Sci. Instr., 32: 387-92(Apr. 1961).

An active bandpass filter was developed with the desirable feature of wide Q control over the range of frequencies extending to ~4 kc. The Q was made as high as 250 with good stability characteristics over this range. The flexibility of the filter was illustrated by the construction of a filter bank tuned to select Fourier components of a 50-cps periodic wave in a typical noise environment and recombine them with no added relative phase shift and with equal gain to improve the signal-to-noise ratio. (auth)

15817 MOLECULAR BEAM ELECTRON BOMBARDMENT DETECTOR. Rainer Weiss (Massachusetts Inst. of Tech., Cambridge). Rev. Sci. Instr., 32: 397-401(Apr. 1961).

A molecular beam electron bombardment detector that detects approximately 1/40 of a neutral beam falling into an area of 3×10^{-2} cm^2 is described. Molecular beams of sulfur dioxide and argon were detected with signal-to-noise ratios of 2000/1 and 500/1, respectively. An improved design is discussed. (auth)

15818 VARIABLE, PRECISION REGULATED, LOW VOLTAGE HIGH CURRENT SUPPLY FOR LARGE ELECTROMAGNETS. R. C. Mobley (Louisiana State Univ., Baton Rouge). Rev. Sci. Instr., 32: 432-3(Apr. 1961).

A hybrid combination of electronic and magnetic amplifiers was successfully and reliably utilized over the past five years in a variable, precision regulated, low-voltage high-current supply for a charged particle deflection magnet. Controlled current range is from 5 to 200 amp at up to 40 v. Despite the nonlinear impedance presented by the magnet's shielded coils, appropriate feedback loops permit an essentially critically damped 0.01% control response throughout the entire current range. As crucially reflected in the magnet's field, regulation and ripple are <0.01%. (auth)

15819 CAPACITOR TECHNIQUE FOR MEASURING THE VELOCITY OF A PLANE CONDUCTING SURFACE. M. H. Rice (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instr., 32: 449-51(Apr. 1961).

A capacitor method for measuring the velocity of a plane, conducting surface is described. An advantage of the method is that the signal voltage developed is essentially proportional to the velocity of the surface instead of to the displacement. Consequently, the method is useful in measuring a surface velocity which persists only over a small displacement interval. (auth)

15820 STEPPING MECHANISM FOR X-RAY AND NEUTRON DIFFRACTOMETERS AND SPECTROMETERS. M. H. Mueller, L. Heaton, and E. W. Johanson (Argonne National Lab., Ill.). Rev. Sci. Instr., 32: 456(Apr. 1961). (ANL-FGF-241)

This motor is a permanent magnet type a-c motor with two field windings. As an a-c motor it has a speed of 72 rpm; however, when direct voltage is applied to the field windings, the motor will lock into a magnetic hold position, and if the voltage is then switched, the motor will advance 1/100, 1/200, or 1/400 of the motor shaft revolution depending upon the switching used. There is no need for braking since the accuracy of positioning each step is extremely great, and any inaccuracy of positioning is non-accumulative. To control the amount of rotation, a transistorized electronic stepping motor control consisting of a pre-set counter and motor drive switching circuit is used. The pre-set counter counts the number of drive pulses delivered to the motor by the switching circuit, and hence the amount of rotation of the motor shaft. After reaching the pre-set amount of rotation, the control automatically stops itself and resets the pre-set counter to zero. This control can be started and stopped manually or automatically and can also drive continuously. (N.W.R.)

15821 FREQUENCY MODULATED, LOW LEVEL, rf SPECTROMETER FOR NUCLEAR RESONANCE. C. H. Dutcher, Jr. and T. A. Scott (Univ. of Florida, Gainesville). Rev. Sci. Instr., 32: 457-8(Apr. 1961).

A nuclear resonance spectrometer circuit described by Robinson lends itself to the combination of low level operation and frequency by means of silicon voltage variable capacitors. This circuit is presented and is used to produce line shape derivatives of pure quadrupole resonances in nitrogenous compounds possessing large asymmetry parameters and at low temperatures. This system is sufficiently stable to conveniently search over long periods of time for unknown resonances. (N.W.R.)

15822 RADIATION METERS. Hans Schenider. VDI Zeitschrift, 103: 360-71(Mar. 11, 1961). (In German)

Specifications are listed for various commercial radiation instruments, such as activity level indicators, instruments for radiation energy measurements, auxiliary instruments, radiation detectors, monitoring apparatus, and measurement devices for special aims. (J.S.R.)

15823 AN ALL-METAL CONTROL VALVE FOR LOW RATES OF GAS FLOW. P. Bouyer, C. Cassignol, and P. Lazeyras (Centre d'Etudes Nucleaires, Saclay, France). Vide, 15: No. 88, 297-300(July-Aug. 1960). (CEA-1535). (In French)

An all metal, adjustable vacuum valve is described. The performance tests show that very minute flows can be controlled. (auth)

15824 RADIATION DETECTOR. W. Graffunder. Belgian Patent 514,192. Sept. 13, 1952. (In French)

The detector is an ionization chamber, the anode of which is connected to the usual electronic devices through a con-

denser. This anode is earthed periodically for a very short time through a switch or a relay. Several ionization chambers for α, β, or γ radiations can be connected to a single indicator by means of a suitable commutator. (EURATOM)

15825 SCINTILLATION COUNTER. (to Université Libre). Belgian Patent 556,593. Apr. 11, 1957. (In French)

The counter is specially designed to measure low-energy β radiations emitted by radioelements in liquid solutions. Small spiral grooves are cut on both sides of a "perspex" plate covered by two sheets of phosphor. The radioactive liquid flows through these grooves and is in contact with the surface of the phosphor. As this surface is large compared to the volume of the solution, the accuracy of the radioactivity measurements, by means of a photomultiplier, is reasonable. Another advantage of this counter is that it can be used to check the radioactivity of a liquid produced in a continuous process. (EURATOM)

15826 IONIZATION CHAMBER. (to N. V. Philips' Gloeilampenfabrieken). Belgian Patent 568,927. Dec. 27, 1958. (In French)

In order to have a wall with the same characteristics as air, concerning radiations, the inventors use B_2O_3 which is also an excellent electrical insulator. It can be welded with aluminum, and de-gassing offers no problems. It is protected against moisture by a layer of celluloid or polyether salt. (EURATOM)

15827 MEASURING DEVICES FOR THERMAL NEUTRON DOSES. (to Commissariat a l'Energie Atomique). Belgian Patent 572,655. Priority date, Nov. 8, 1957. (In French)

Essentially the dose-meter consists of a thin strip, or several strips, of a material absorbing thermal neutrons. Neutron bombardment provokes anisotropic expansion of the strip which bends toward the neutron source. Screens can be used to protect the other side of the strip when required. B and Li as well as B_4C are used to manufacture or coat the neutron-absorbing strip. (EURATOM)

15828 PHOTOGRAPHIC FILM FOR PRECISION MEASUREMENTS OF HIGH ENERGY RADIATION. (to AGFA). Belgian Patent 572,842. May 11, 1959. (In French)

Fluorescent substances are incorporated during manufacture in a layer of silver halide emulsion. Amounts and grain sizes are chosen so that the sensitivities of both substances are such that they show very little dependence on the radiation wavelength. Mineral and organic fluorescent substances can be used, but those which are insoluble in water are preferred. (EURATOM)

15829 DEVICE FOR THE SELECTIVE DETECTION OF FISSION PRODUCTS IN A GASEOUS FLOW. J. Goupil and A. Roguin (to Commissariat a l'Energie Atomique). Belgian Patent 573,563. June 3, 1959. (In French)

Long-lived and short-lived fission products occur in the cooling gas of a reactor in case of a burst slug. The short-lived products are measured selectively, in a by-pass, by two opposed beta scintillation counters. The selection is based on the fact that after settling for 20 to 30 seconds in the counting chamber, the short-lived fission products have an activity which is almost nil. (EURATOM)

15830 NEUTRON FLUX DOSE-METER MADE OF GLASS. (to Societe Saint-Gobain). Belgian Patent 580,511. Priority date, Sept. 5, 1958. (In French)

Basically the dose-meters are made of two thin glass plates or two glass wires, welded together but of different composition. One contains a large amount of boron or lithium and the other is ordinary silicon glass. When submitted to the action of neutrons, these two different glasses react differently and show a marked curvature which is proportional to the integrated neutron flux. (EURATOM)

15831 β RAY GEIGER MÜLLER COUNTER. (to N. Philips' Gloeilampenfabrieken). Belgian Patent 582,130. Priority date, Mar. 30, 1958. (In French)

The tube comprises a cylindrical cathode closed at one end by a window which is metallized on the inside in order to ensure a good electrical contact with the cathode. The part of the anode facing the inside of the window is approximately hemispherical, and this particular geometry is responsible for a considerable lowering of the background noise. (EURATOM)

15832 IMPROVEMENTS IN OR RELATING TO NUCLEAR PARTICLE DISCRIMINATORS. Francis Dey Brooks (to United Kingdom Atomic Energy Authority). British Patent 862,331. Mar. 8, 1961.

A circuit is described for discriminating between types of particles detected by scintillation counters based on different decay times of the scintillations. In the circuit, one form of that claimed in British Patent 823,263, two pulses are derived from a photomultiplier tube, the pulse amplitudes being proportional to the area and amplitude of the scintillation pulse, respectively, and a difference pulse in turn is derived from these pulses and applied to a pulse amplitude discriminator. The electrodes for producing the pulses are the anode and a dynode, and the deriving means are such that the pulses are of opposite polarity. A connection including a resistor is made between each deriving means and a common output resistor across which the difference pulse is developed. (D.L.C.)

15833 IMPROVEMENTS IN OR RELATING TO NEUTRON DETECTORS. (to Siemens-Schuckertwerke A. G.). British Patent 862,379. Mar. 8, 1961.

A neutron probe is designed for use in nuclear reactors whose neutron flux is to be measured. The probe is embedded in an envelope consisting of an inner layer of a moderator of large diffusion length, a central layer of a reflector of small diffusion length, and an outer layer of a strong neutron absorber. The envelope bears directly against a γ absorber plate between the reactor vessel and the biological shield. The advantage of the neutron probe is that disturbing influences such as impinging γ radiation and coupling with other probes are obviated. Various configurations of the probe for use with fast neutrons, other probes, etc., are described. (D.L.C.)

15834 IMPROVEMENTS IN OR RELATING TO METHODS OF TESTING NEUTRON RADIATION. (to Siemens-Schuckertwerke A. G.). British Patent 862,425. Mar. 8, 1961.

A neutron-detecting device is designed in which a semiconductor, preferredly InP or InN, is irradiated by the neutron flux and the momentary changes in its electric properties measured. The measurements are plotted as a function of time and then evaluated to differentiate between the constant and variable parts which indicate the flux intensity and the neutron components of a radiation mixture, respectively. A circuit for this device is described which can be used to detect extremely weak neutron fluxes. (D.L.C.)

15835 MEASUREMENT OF GAMMA RAY ENERGY DUE TO INELASTIC NEUTRON SCATTERING. Richard Louis Caldwell and Tom Wilkerson Bonner (to Socony Mobil Oil Co., Inc.). British Patent 862,434. Mar. 8, 1961.

A well-logging device is described which is based on the t that certain elements (C, O, and S), but not other ele-nts (Na, Fe, Mg, and Cl), in earth formations emit char-eristic γ rays when bombarded by neutrons of a selected ergy. The device is an exploring unit designed to travel ng a bore hole and which contains a neutron source and detection system (scintillator, photomultiplier, and se height analyzer). The neutron source, which gives off utrons of energy at least 2.3 Mev, is either a tritium–uterium reactor or a Ra–Be source; in the latter case, a d shield is interposed between the source and the detec-to block off the γ rays emitted by the source. (D.L.C.)

836 IMPROVEMENTS RELATING TO MAGNET AS-MBLIES. Edward Watson and Mervyn Sidney Avery (to irey Co., Ltd.). British Patent 863,272. Mar. 22, 1961.

A magnet assembly for establishing magnetic fields is signed for use in nuclear magnetic resonance detectors. e assembly comprises a pair of pole pieces with faces fining an air gap; one pole piece is mounted relative to e other so as to be free to move toward or away from e other and to rock in order to take up misalignment. Slip ges are also provided between the opposed pole faces to ld them exactly parallel. (D.L.C.)

837 METHOD AND APPARATUS FOR MEASURING ARIATIONS OF EFFECTIVE NEUTRON-CAPTURE ROSS-SECTION. (to Commissariat a l'Energie Atomique). ritish Patent 863,567. Mar. 22, 1961.

A method is outlined for measuring the relative varia-ons of the effective neutron-capture cross section along a od or bar. In this method, the rod is passed into a graphite le perpendicularly to a thermal neutron flux with a neu-on detector on the side of the rod away from the source. he detector response curve thus obtained is corrected for nsity errors by gamma ray measurements and reference urves for samples with known density errors. The cor-ected curve then can be used to determine the distribution absorbent impurities in the rod. (D.L.C.)

838 IMPROVEMENTS IN OR RELATING TO SPE-IFIC METERS. Ian James Smith, Alistair Fredric Donald cott, and John Walton Marshall (to United Kingdom Atomic nergy Authority). British Patent 864,665. Apr. 6, 1961.

A meter is designed for measuring the specific gravity of adioactive liquids. The meter comprises a closed vessel aving two tubes dipping therein at different levels, a liquid nlet at the bottom, and an evacuation port at the top. In op-ration, the liquid inlet is lowered into the liquid whose pecific gravity is to be measured, the vessel is evacuated ntil the liquid rises to the higher tube, and the pressure ifference in the tubes is read on a manometer connected etween the two tubes. The specific gravity is then found rom a pressure difference vs. specific gravity calibration urve. (D.L.C.)

5839 IMPROVEMENTS IN OR RELATING TO MICRO-WAVE SUPPORTING STRUCTURES. George Brian Walker nd James Trevor Hyman (to United Kingdom Atomic En-rgy Authority). British Patent 865,367. Apr. 12, 1961.

A surface which is highly reflecting for microwaves can e constructed by spacing a quarter-wave layer of dielec-ric material a quarter-wave length from a metal surface. The dielectric material must have a loss factor tan δ and a dielectric constant ϵ satisfying the equation $(\sqrt{\epsilon}\tan\delta)/(\epsilon-1) < \sqrt{\mu\omega/2g}/30\pi^2$, where ω is the angular frequency of the supported microwave and g and μ are the conductivity and permeability of the metal surface, respectively. Vari-ous configurations of the surface are described for use as waveguides and resonant cavities. (D.L.C.)

Materials Testing

15840 (AWRE-0-53/60) A HIGH TEMPERATURE TENSILE TESTING MACHINE. F. Morrow (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Mar. 1961. 13p.

A description is presented of the design and operation of a remotely controlled tensile machine capable of testing radioactive or toxic specimens at temperatures up to 1000°C in vacuum or controlled atmospheres. (auth)

15841 (JAERI-6002) DESIGN AND CONSTRUCTION OF COBALT-60 GAMMA RADIATION FACILITY. Report No. 2. (Japan Atomic Energy Research Inst., Tokyo). July 1960. 27p.

An irradiation cave with a 10-kilocurie Co^{60} source for testing non-metallic materials used for reactors, and for studying radiation chemistry is described. The cave is designed for dose rates greater than 10^6 r/hr under varied but controlled material sample conditions, and is planned so that the operating area dose rate is less than 30 Mr per 48 hr week. The source cylinder and safety systems are also described. (J.R.D.)

15842 (KAPL-A-HL-1) HOT LABORATORY TEST APPARATUS. (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 1961. Contract W-31-109-eng-52. 53p.

The equipment and services available at the KAPL Radioactive Materials Laboratory are described. Capsule Disassembly. A remotely controlled lathe and a vertical lathe disassembly table are provided for capsules of various sizes. Equipment for obtaining gas and liquid metal samples are described. Machines for sectioning samples for tests are also available: dry sectioner, underwater cut-off wheel, hacksaws, shear apparatus, metal punching device, and drill. Nondestructive Tests and Inspection Services. Equipment for sample radiation and visual scanning and measurements of dimensions, weight, density, and center of gravity are described. Mechanical Property Tests. Possible ranges of temperature, atmosphere, etc., and equipment limitations are given for tensile, hardness, impact, strain fatique, creep (short and long term), metallographic, and bend tests. Other Services. These services include chemical dissolution for burnup analysis, autoclave corrosion studies (static and dynamic), and annealing. A remote milling machine is available for preparing tensile samples. Specifications for Recommended Samples. Sample specifications are given for impact (Izod and Charpy), tensile, tension, creep, rupture, bend, and corrosion testing. (D.L.C.)

15843 (WADD-TR-61-91(Pt.I)) ULTRASONIC METHODS FOR NONDESTRUCTIVE EVALUATION OF CERAMIC COATINGS. W. E. Lawrie (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Feb. 28, 1961. Contract AF33(616)-6396. 42p.

A description is given of investigations on the use of ultrasonics to detect defects in ceramic–metal bonds and to measure the strengths of the bonds. Ultrasonic frequencies from 30 cps to 35 Mc/sec were used, and in one method, two frequencies were used simultaneously. Low-frequency energy (14 kc/sec) was successfully used to detect defects by decrement measurements. Low frequencies were also used in further studies of the intermodulation method used to locate regions of bonds in which defects are present. High frequencies up to 35 Mc/sec were used with a transmission method and visual images of defects are displayed using a simple charge scanning technique. High-frequency energy was also used in the form of surface waves. (auth)

15844 (AEC-tr-4139(p.232-9)) THE USE OF RADIOACTIVE ISOTOPES FOR DETECTION OF NON-FUSIONS AND THE EFFECT OF THESE NON-FUSIONS ON DURABILITY OF WELDED JOINTS. S. V. Rumyantsev.

A study was made of the sensitivity of welded joints of 30KhGsna steel, 1Kh18N9T steel, and D16T duralumin to non-fusions in V-shaped seams. Tests of static tenacity, vibrational and static endurance, and impact bending were made. The results show that the nature of the load is a factor involved, as well as plastic properties. The photometric curve derived from the gamma picture should be used to determine the depth of non-fusions where other procedures fail. (T.R.H.)

15845 (AEC-tr-4139(p.240-9)) EUROPIUM-155 AND CERIUM-144 AS SOURCES OF RADIATION FOR GAMMA-RADIOGRAPHY OF METALS. S. V. Rumyantsev and L. N. Matsyuk.

A study was made of the possibilities of using Eu^{155} and Ce^{144} as radiography sources. After a summary of the physical properties of each, a sensitivity evaluation of the two sources is made by comparison of results with Tm^{170}, Ir^{192}, Cs^{137}, and Co^{60}. A chart is prepared showing which of the six isotopes is best for radiography of steel, Ti alloys, Al alloys, and Mg alloys of different thicknesses. (T.R.H.)

15846 (NP-tr-585) METAL STRENGTH AND NO-LOAD STRESSES OF THE SECOND KIND INDUCED BY A DECREASE IN TEMPERATURE. G. P. Zaytsev. Translated from Fiz. Metal. i Metalloved., 2: 494-503(1956). 2(

An approximate calculation was made of stresses of the second kind which emerge in a two-phase metal after a te perature change. The effects of these stresses on metal strength were also considered. Expansion-compression stresses which mutually equalize each other within the limits of one or more adjacent crystallites were defined as the no-load stresses of the second kind. Formulas wer derived for stresses on the inner surface of a sphere laye the outer surface of the sphere layer, the outer surface of the sphere, hydrostatic stresses, and maximum shearing forces. Temperature stresses of the second kind were determined in No. 3 steel with spheroidized cementite. Th effects of a change of rate in cooling, within the limits of speeds corresponding to perlite transformation, on the me chanical properties of medium-carbon steel were investigated. (M.C.G.)

15847 (SCL-T-358) STATE OF STRAIN IN AN ANNULAR (CORRUGATED) DIAPHRAGM. K. Stange. Translated by Marcel I. Weinreich (Sandia Corp.) from Ing.-Arch., 2: 47-91(1931-32). 81p.

Stresses and strains in corrugated membranes under the weight of pressure and other forces are analyzed, differential equations are derived, and various solutions are proposed for the equations. The corrugated surface of the membrane is assumed to be made out of conical and annular shell portions. (D.L.C.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

5848 (ANL-6288(p.24-30)) WEATHER MODIFICATION. D. C. Hess and M. B. Rodin (Argonne National Lab., Ill.).

A system is proposed whereby clouds are prevented from dropping their moisture content on the windward side of a mountain range by artificially adding sufficient heat so that they may rise enough to clear the mountains without cooling to a temperature which would cause precipitation. Two ways of delivering heat to the cloud are transmission as electromagnetic radiation, principally in the near infrared region, and direct contact by use of airborne heaters. The infrared transmission system is handicapped by a large amount of absorption in the atmosphere, large size, and the necessity of developing high temperatures over large areas to handle the power needed. It may prove feasible for special applications. A suggested reflector system is described and a calculation is made for heating by direct contact. (auth)

5849 (CEA-1684) APPLICATION DES MESURES DE RESISTIVITE A LA RECHERCHE DES ELEMENTS STRUCTURAUX DANS LE BASSIN URANIFERE DU NORD-LIMOUSIN (FRANCE). (Application of Resistivity Measurements to Research on Structural Elements in the Nord-Limousin (France) Uraniferous Basin). Jean A. Sarcia, J. Bonnet, and R. Combe (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). 1960. 12p.

Difficulties encountered in the exploration of a typical uranium deposit in the Nord-Limousin, using the resistivity measurement method, are discussed. In the zone in question the overthrust was very variable and difficult to predict. The uraniferous deposits had two types of aspect, the passage from one to the other being often very sudden: long thin veins without gangue; short and thick lens-shape deposits which were strongly contaminated by clay towards their edges. After several unsatisfactory attempts, the device known as the rectangular map was adopted and gave an acceptable structural representation rapidly and cheaply. For placing the probes however, methods are required which are more refined and sensitive. It is in any case useless to expect to obtain a satisfactory representation and a sufficient accuracy using a single technique, especially in the region under consideration. (auth)

15850 (CEA-1751) ETUDE DE LA VOCATION DES SOLS EN PLACE A LA RETENTION DU RADIOSTRONTIUM. (A Study of the Retentive Power of Soils Under Natural Conditions for Radiostrontium). P. Bovard and A. Grauby (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1960. 25p.

Independently of a theoretical study of the propagation of radioactivity in soil as a result of submersions or of radioactive rain, studies were made of how radioactivity can vary in the soil. A simple, rapid method was perfected which makes it possible to maintain for each soil sample the natural parameters (structure, humidity, etc.) without introducing boundary effects. In the laboratory, after charging the soil samples, part of the study of the propagation of radioactivity is done by autoradiography. As a practical application, the study of an atomic site illustrates the methods. (auth)

15851 (NP-10025) A NOTE ON THE PREDICTION OF RADIATION INTENSITIES DUE TO FALLOUT FROM A SINGLE OR FROM MULTIPLE NUCLEAR EXPLOSIONS. G. H. Gilbert (Canada. Defence Research Board). Dec. 1960. 12p. (CD-6)

A method is presented for estimating future values of the radiation intensity due to fall-out from measured values of the intensity made over relatively short periods of time. The method is applicable even when the radioactivity is due to combined fall-out from two or more nuclear explosions. Characteristic curves are presented whereby the decrease of radiation intensity with time may be readily compared with the corresponding decrease for some theoretical rate of decay. A number of theoretical examples relating to radioactivity from two or more nuclear explosions are considered. Results of these theoretical examples are discussed. (C.H.)

15852 (OTS-60-51187) THE MOISTURE PROPERTIES OF SOILS AND UNDERGROUND STRATA. A. A. Rode (Akademiya Nauk S.S.S.R.). Translation of a publication by the Academy of Sciences of the U.S.S.R., Moscow, 1955. 117p. (PST Cat.-30)

A review is presented of results from studies on factors which affect soil moisture. Topics discussed in detail include soil porosity, properties of water, the retention of water by soil, free water, suspended moisture, the influence of aeration porosity on water yield capacity; factors affecting the availability of soil moisture for plants; the permeability of soils; states of moisture in soils; substrate moisture constants; moisture properties of some types of soils, methods of expressing moisture constants of soils and substrata; and methods for the artificial modification of moisture properties of soil. (C.H.)

15853 (TID-11102) LETTER PROGRESS REPORT FOR SEPTEMBER, 1960. (General Mills, Inc., Minneapolis). October 25, 1960. Contact AT(11-1)-401. 13p.

The large volume direct-flow samples as modified for a filter exposure of two square feet was hitch-hiked on two flights. The first was a successful test. The second failed when the balloon burst prematurely. On the successful flight the large volume unit demonstrated its ability to draw at a rate of 1120 cfm when powered by 30 volts. Collection efficiencies exceeding 90% were achieved. (W.L.H.)

15854 (TID-12314) PROPAGATION VELOCITY OF LONGITUDINAL WAVES IN ROCKS. EFFECT OF STATE OF STRESS, STRESS LEVEL OF THE WAVE, WATER CONTENT, POROSITY, TEMPERATURE, STRATIFICATION AND TEXTURE. John S. Rinehart, Jean-Pierre Fortin, and Lorraine Burgin (Colorado School of Mines Research Foundation, Inc., Golden). Jan. 20, 1961. For California. Univ., Livermore. Lawrence Radiation Lab., Purchase Order No. 5599407. 72p.

Existing data on propagation velocity of longitudinal stress waves in rocks are reviewed and summarized. Values of propagation velocity for typical rocks are given. The velocities were found to be higher for more dense and compact rocks. The range in velocity did not exceed 15% for rocks with a well-defined texture. Propagation velocity generally increased 10 to 30% above the initial value when

the pressure was increased. When uniaxial stress was applied to a rock the velocity in a direction parallel to the stress was 10% higher than the velocity in a direction perpendicular to the stress. The variation of velocity, −30 to +40%, due to variation in water content did not depend on the rock type. Propagation velocity decreased with porosity agreeing with Biots' theory. Generally, an increase in temperature caused a decrease in velocity of 1 to 5% per 100°C. Only part of this decrease was reversible on cooling. Frequency had little effect on velocity causing a change of less than 2% when the frequency was varied from 40 to 4,500 cps. (M.C.G.)

15855 (TID-12315) LARGE NON-NUCLEAR EXPLOSIONS, THEIR NATURE AND EFFECTS. Jean-Pierre Fortin, Lorraine Burgin, and John S. Rinehart (Colorado School of Mines Research Foundation, Inc., Golden). Mar. 10, 1961. For Univ. of California Lawrence Radiation Lab. 110p.

Data on the nature and principal effects of large explosions, cratering and redistribution of rocks, rock breakage, seismic effects, and air blast effects were collected. Detailed information concerning several big explosions is given. In the first approximation two types of rocks were considered: soil without tensile strength, and unfractured rocks. Baldwin's relationship between the depth and the diameter of the crater produced by surface explosions is discussed. The redistribution of rock for a concentrated charge can be characterized by the height and width of the rim. The types of rock fracture occurring when a confined charge explodes are described. Seismic effects of an explosion were found to be characterized by maximum vertical and horizontal amplitude of the motion, the dominant frequency, and the duration of the vibrations. The formation of the shock and pressure waves for explosions in air is described. (M.C.G.)

15856 (TID-12316) NOTES ON THE HISTORY OF EXPERIMENTAL STUDIES OF ELASTIC, ESPECIALLY DYNAMIC, PROPERTIES OF ROCK. Michele Auberger, Lorraine Burgin, and John S. Rinehart (Colorado School of Mines Research Foundation, Inc., Golden). May 10, 1960. For Univ. of California. Lawrence Radiation Lab. 34p.

The elastic properties of rocks have been studied in different branches of science, namely physics, geophysics, seismology, mining, and petroleum engineering. The principal steps of experimental studies in the laboratory and field are pointed out briefly, and some gaps in these studies and some new directions for additional research are shown. (200 references) (auth)

15857 (TID-12317) ANELASTICITY OF ROCKS (A REVIEW). Michel Auberger and John S. Rinehart (Colorado School of Mines Research Foundation, Inc., Golden). June 30, 1960. For Univ. of California. Lawrence Radiation Lab. 54p.

Anelasticity is defined and the importance of attenuation in understanding the behavior of rocks under a dynamic stress is shown with special reference to the case of small amplitude stresses. The principal characteristics of the well-known rheological models explaining the anelasticity of the real materials are given. A review is presented of the literature on the study of the anelasticity of rocks under a dynamic stress and of attenuation as a function of frequency. Most of the known data are compiled. (auth)

15858 (TID-12319) VELOCITY AND ATTENUATION IN ROCKS AS FUNCTIONS OF FREQUENCY. Final Report. Michel Auberger and John S. Rinehart (Colorado School of Mines Research Foundation, Inc., Golden). Sept. 1960. For Univ. of California. Lawrence Radiation Lab. 31p.

The methods used and the results obtained are discussed for three previous reports: "Anelasticity of Rocks (a review)", "Energy Loss Associated with Impact of Steel Spheres on Rocks", and "Ultrasonic Velocity and Attenuation of Longitudinal Waves in Rocks." Two conclusions are given for attenuation at frequencies >200 kc/sec: (1) Attenuation values for rocks are much higher than for metals and plastics in the same frequency range; hence, the approximation of considering the logarithmic decrement as equal to the attenuation in nepers per wavelength is not valid for rocks. (2) No scattering was observed with an attenuation coefficient proportional to the fourth power of the wavelength. An appendix is included giving the particle size distributions of the components of several rocks tested. (D.L.C.)

15859 (TID-12321(Pt.I)) SOURCES OF INFORMATION ON ROCK PHYSICS. PART I. Lorraine Burgin and John S. Rinehart (Colorado School of Mines Research Foundation, Inc., Golden). June 10, 1960. For Univ. of California, Lawrence Radiation Lab. 37p.

Sources of information on the physical properties of rocks and on rock mechanics are presented. In an effort to make available a list of which specific physical properties were determined and some of the rocks that were tested, the major references listed include the physical properties for which data are given and the rocks and their location. The references are divided into three groups: government publications, other important sources of information, and current literature. (M.C.G.)

15860 (TID-12321(Pt.II)) SOURCES OF INFORMATION ON ROCK PHYSICS. PART II. SYMPOSIA ON ROCK BEHAVIOR. Lorraine Burgin (Colorado School of Mines Research Foundation, Inc., Golden). Aug. 12, 1960. For Univ. of California. Lawrence Radiation Lab. 130p.

A literature review concerned with the various symposia on rock behavior as it applies to mining is presented. Twenty-one conferences and symposia are covered. The papers presented at the various symposia are listed. The articles are annotated giving the types of rock investigated, the theories and location of the tests, etc. (M.C.G.)

15861 (TID-12321(Pt.III) SOURCES OF INFORMATION ON ROCK PHYSICS. PART III. Current Literature, September—December 1960. Lorraine Burgin (Colorado School of Mines Research Foundation, Inc., Golden). Jan. 20, 1961. For Univ. of California. Lawrence Radiation Lab. 47p.

A literature list is given for the following subjects: physical properties of rock, wave propagation, rock mechanics, and related subjects, e.g., seismology. The references were mostly taken from publications appearing in Sept. to Dec. 1960, although older papers are also included. (D.L.C.)

15862 (TID-12321(Pt.IV)) SOURCES OF INFORMATION ON ROCK PHYSICS. PART IV. Current Literature, January 1961. Lorraine Burgin (Colorado School of Mines Research Foundation, Inc., Golden). Feb. 28, 1961. For California. Univ., Livermore. Lawrence Radiation Lab., Purchase Order No. 5599407. 39p.

A current literature review concerning the physical properties of rock, rock mechanics, wave propagation, and related material is presented. The December 1960 and January 1961 issues of journals and indexes were scanned. Notes and abstracts are included for most references. (M.C.G.)

15863 (TID-12393) A STUDY OF FISSION ISOTOPE RATIOS OBTAINED FROM THE ASH CAN STRATOSPHERIC SAMPLING PROGRAM. S. C. Stern (General Mills, Inc., Minneapolis). [1960]. Contract AT(11-1)-401. 26p.

Fission isotope ratios for Sr^{89}/Sr^{90} were analyzed for 0000 ft, 65000 ft, 80000 ft, and 90000 ft elevations from)ctober 1956 through July 1959; Ba^{140}/Sr^{90} activity ratios ere analyzed from the latter part of 1957 through 1958 for similar altitudes; and Zr^{95}/Sr^{90} activity ratios were analyzed for 6500 ft from October 1956 through July 1959. The activity ratios obtained were used to determine apparent sources of radioactive debris in Arctic and equatorial stratospheric air masses. The ratios were also used to determine approximate amounts of mixing between the initial radioactive injection and residual local stratospheric radioactivity. Some evidence was found that dilution of equatorial injections is much greater than Arctic injections. It was found from nearly simultaneous observations that latitudinal and vertical differences in concentration exist in debris from either the same or different sources. Once established in a stratospheric circulation, radioactive clouds can maintain their identity for periods of at least eight months. Some evidence was also found that an Arctic injection may penetrate the Southern Hemisphere. (C.H.)

15864 (TID-12394) RADIOACTIVE RARE EARTHS FROM FALLOUT FOR STUDY OF PARTICLE MOVEMENT IN THE SEA. Thomas T. Sugihara (Clark Univ., Worcester, Mass.) and Vaughan T. Brown (Woods Hole Oceanographic Institution, Mass.). 1960. 12p. (RICC/195)

Samples of sea water were collected from the surface and at various depths at a number of locations in the Atlantic Ocean between 1956 and 1958. The samples were analyzed for Ce^{144} and Pm^{147}. Results are compared with data on Sr^{90} levels in the samples. The ratios Ce:Pm and Ce:Sr are interpretable in relation to the same ratios for production in fission explosions. Applications of these ratios as indicators of the age of fission product mixtures in sea water are discussed. Data indicate that Pm and Ce are removed from surface sea water by becoming associated with sinking particles. (C.H.)

15865 (TID-12502) TABLES FOR RAPID COMPUTATION OF POTENTIAL TEMPERATURE. Georg Wüst (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory). Jan. 1961. Contract AT(30-1)1808. 10p. (CU-9-61-AT(30-1)1808 Geol.)

Tables are presented for computing for deep ocean water samples their potential temperatures, or the temperatures which they would attain if raised adiabatically to the sea surface. The tables include interpolations of the data of V. W. Ekman and Helland-Hansen. The validity of Ekman's value for the thermal expansion coefficient is discussed. (D.L.C.)

15866 (UCRL-6311) THE HUGONIOT EQUATION OF STATE OF ROCKS. David B. Lombard (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 28, 1961. Contract W-7405-eng-48. 28p.

Hugoniot equations of state were determined for rock salt, granite, tuff, marble, dolomite, limestone, andesite, basalt, taconite, oil sand, and oil shale. In these determinations, plane hydrodynamic shocks were produced and transmitted to rocks, and the shock velocity and free-surface velocity were measured. The procedures and results are discussed. An instrument was developed which uses pin contactors to measure chock velocity and free-surface velocity in the rock not far from the explosion. (D.L.C.)

15867 (AEC-tr-4376(p.167-73)) SAMPLING OF GRANITES FOR RADIOCHEMICAL STUDY. I. E. Starik and A. Ya. Krylov. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 7: 149-54(1956).

Methods of sampling granites in order to determine the distribution of thorium and uranium in them are discussed. The method used is determined by the following factors: objectives and objects of sampling, dimensions of massif being studied and feasible volume of work, geological singularities, and the nonuniformity of the distribution of U and Th in the granites. It was found that any modification of the point method may be used for sampling granite massifs. Two examples of collection of a particular specimen from various areas and with different numbers of lumps composing the sample are given. Expressions were derived for the variability of the content of any element and the reliability of its value. Area lump sampling of granites was found to be less reliable than sampling by composite specimens. The number of samples that is necessary and sufficient to characterize a given massif or part of it can be determined approximately on the basis of an established or hypothetical variation coefficient and the specified sampling error. (M.C.G.)

15868 (AEC-tr-4376(p.174-220)) ON THE GEOCHEMISTRY OF THE RADIOACTIVE ELEMENTS IN ROCKS OF THE KIROVOGRAD-ZHITOMIR MAGMATIC COMPLEX OF THE UKRAINE. RADIOACTIVE ELEMENTS IN GRANITES OF THE KIROVOGRAD AND ZHITOMIR TYPES. L. V. Komlev, M. S. Filippov, S. I. Danilevich, and K. S. Ivanova. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 7: 155-99(1956).

A study was made of the distribution of radioactive elements in the rocks of various recently resolved magmatic complexes of the Ukrainian crystalline shield. The extensive distribution in the Ukraine of intrusions of coarse-grained porphyritic Kirovograd-type granites and the associated gray, medium-grained granites of the Zhitomer type, pink aplitoid granites and pegmatities determined to a significant degree a number of characteristic geochemical singularities of the region. The Clarke abundances of the radioactive elements in the granites of the complex were calculated on the basis of analysis of 107 specially prepared specimens of the two chief granite varieties, the Kirovograd and Zhitomir types, which were sampled over all of the principal massifs of the Ukrainian crystalline shield. Values of $5.7 \times 10^{-4}\%$ for uranium and $3.3 \times 10^{-3}\%$ for thorium were obtained. A tendency toward a depression in the geochemical role of uranium and an elevated content of thorium and of the rare earths was found to be characteristic for the granites of the complex. Sharp differences in radioisotope content were established for individual intrusions. (M.C.G.)

15869 (AEC-tr-4376(p.221-30)) DISTRIBUTION OF URANIUM AND THORIUM IN THE DZHETY-OGUZ GRANITIC MASSIF (First Report). A. Ya. Krylov. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 7: 201-8 (1956).

A study was made of the distribution of U and Th in the Dzhety-Oguz granite massif. This massif is composed of leucocratic, medium-grained red biotitic granites. A comparison was made of the chemical composition of granites from various areas of the massif and the surrounding rocks near the contact. U and Th were found to be distributed nonuniformly both within the granite and in the contact rocks. Within the granite massif, a slight decline in the thorium content was observed from the center of the massif to its periphery. However, a noticeable increase in the uranium content was observed in the same direction. A sharp increase in the uranium content and a sharp decline in thorium content was found in the rocks of the exocontact zone. The U and Th contents in the contact apophyses of the granite-

porphyrys and quartz-porphyrys were approximately the same as in the endocontact granites. The content of uranium in the granitized-hornstone zone was about the same as in the granites, while the thorium content was lower by a factor of 2 or 3. In the zone of chertization, the U and Th content was lower than in the granites. (M.C.G.)

15870 (AEC-tr-4376(p.231-5)) DISTRIBUTION OF URANIUM AND THORIUM IN THE ALABASH GRANITIC MASSIF (Second Report). A. Ya. Krylov. Translated from Trudy Radievogo Inst. im. V. G. Khlopina, 7: 209-13(1956).

The distribution of U and Th in the granite massif located in the Alabash pass was investigated. The intrusion is composed of medium-grained red granites. The surrounding rocks are represented by amphibolite-biotite-quartz-feldspar hornstones and phyllites. They were found to contain considerable quantities of magnetite. The uranium content was found to vary from 4.4×10^{-4} to 5.3×10^{-4}% from the center to the surfaces, while thorium varied from 2.2×10^{-3} to 1.6×10^{-3}%. A sharp decline in both U and Th contents was noticed in the xenolith zone. (M.C.G.)

15871 EXTENT OF THE GRANITIC PLUTONIUM IN THE KARAKORUM AND IN THE HINDU KUSH (CENTRAL ASIA). Ardito Desio. Atti acad. nazl. Lincei. Rand., Classe sci. fis., mat. e nat., 28: 783-6(June 1960). (In Italian)

A summary is given of the extent of the principal plutonium ores in Karakorum and the Hindu Kush. (J.S.R.)

15872 URANIUM MINERALIZATION AT THE MIDNITE MINE, SPOKANE, WASHINGTON. Jonathan Barrington and Paul F. Kerr. Econ. Geol., 56: 241-58(Mar.-Apr. 1961).

The Midnite Mine is located approximately 35 air miles northwest of Spokane, Washington, near the confluence of the Columbia and Spokane Rivers on the Spokane Indian Reservation. Uranium mineralization occurs in a zone along the contact between the Cretaceous Loon Lake granite and Precambrian metasediments. Ores appear to be found within and near associated fractures and shear zones. Secondary, oxidized uranium minerals, principally autunite and meta-autunite, lie above a fluctuating water table, while below this water table there occurs a zone of partially oxidized, sooty and compact uraninite. Sulfide mineralization is associated with the uraninite. Associated zones of argillic alteration that contain kaolinite, illite, montmorillonite and intermingled adularia further indicate the action of hydrothermal solutions. Botryoidal masses of marcasite and shrinkage cracks in the uraninite imply colloidal precipitation in the formation of the primary uranium ore. Ore deposition is inferred to have taken place at temperatures on the order of 300°C in a neutral or slightly acidic environment. (auth)

15873 LATE PLEISTOCENE AND RECENT ACCUMULATION OF URANIUM IN GROUND WATER SATURATED SANDSTONE DEPOSITS. John N. Rosholt, Jr. (Univ. of Miami, Fla.). Econ. Geol., 56: 423-30(Mar.-Apr. 1961).

Protactinium-231 and thorium-230 relations in several ground water saturated sandstones containing uranium ore indicate that much of the uranium has been accumulating in very recent times. Samples from the Hauber mine, Crook County, Wyoming, were selected to illustrate the concept of recent accumulation and the methods of calculation of the estimated minimum and maximum dates of the start of the uranium accumulation. The radiochemical results of eight samples from this mine show extremely consistent radioactive daughter product distribution, and a close correlation between the estimated dates of the start of uranium accumulation and the uranium content of the ore. The results for mill pulp samples, representing large tonnages of ore, indicate that the major part of uranium deposition started between 40000 and 130,000 years ago and the rate o deposition has increased approaching the present time. (auth)

15874 RADIOACTIVITY IN MONAZITE, ZIRCON, AND "RADIOACTIVE BLACK" GRAINS IN BLACKSANDS OF ROSETTA, EGYPT. Amin R. Gindy (Alexandria Univ., Egypt). Econ. Geol., 56: 436-41(Mar.-Apr. 1961).

More than 50 different heavy minerals are known to occur in the Egyptian Nile deposits. Small scale concentrations form on the beaches of the Nile delta, the most important occurring near the Rosetta. A variety of techniques employing nuclear emulsions were used to measure the radioactivity of individual grains of monazite, zircon, and black sands from representative Rosetta samples. The specimens are described, and results from measurements of radioactivity are presented graphically. (C.H.)

15875 HEAT FLOW FROM A DIFFERENTIATED EARTH. Sydney P. Clark, Jr. (Carnegie Institution of Washington, D. C.). J. Geophys. Research, 66: 1231-4 (Apr. 1961).

Calculations are made of the heat flow from an initially cold earth with radioactivity distributed uniformly through a surface shell, with account taken of radioactive decay. It is found that the heat flow exceeds the heat produced by about 10 per cent if the abundances of radioactive elements are the same as in chondrites and the radioactive shell is less than about 300 km thick. The heat flow calculated in this way exceeds the observed value, but neither figure is considered known accurately enough to warrant rejection of the chondrite model of the earth. (auth)

15876 NUCLEAR PHENOMENA AFFECTING THE ISOTOPIC COMPOSITION OF METEORITES. Borbála Gyarmati. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen). Közlemények, 2: 213-16(1960). (In Hungarian)

One of the chief factors which may contribute to the shift of the isotopic ratio from that prevailing on the earth is the cosmic radiation which is able to penetrate the nucleus, transmitting its energy to a nucleon. This may ultimately result in a cascade and the creation of an excited nucleus. Before the thermodynamic equilibrium could be established, several as yet unknown intermediate phenomena may take place. After about 10^{-22} sec the nucleus will be heated up and will start to evaporate which may ultimately change the isotopic ratio. On the other hand, theoretical considerations indicate that the effect of neutrino radiation can be neglected. The possibility of a strong neutron radiation in the space cannot be excluded but calculations indicate the escape energy of neutrons from the sun makes the probability of thermal neutrons leaving the sun very small. This question can be answered with certainty only on the basis of data obtained by means of space rockets and satellites. Internal factors may involve the natural radioactive ratios between parent and daughter elements as can be determined from chemical and isotopic distribution of elements between the metallic and silicate phases of the meteorites. Study of the daughters of the long half-life isotopes promises to be fruitful. (TTT)

15877 GENERAL CHARACTERIZATION OF METEORITES ESPECIALLY FROM THE VIEWPOINT OF THEIR CHEMICAL COMPOSITION. Zoltán Sámsoni. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen). Közlemények, 2: 207-12(1960). (In Hungarian)

The meteorites the size of which varies from meteoric

dust to pieces weighing many tons, are divided in 3 classes: siderites, sideriolites and aerolites, according to their composition of Fe–Ni alloys, Fe and Si, and silicates, respectively, thus representing a close analogy with the geochemical structure of the earth. While known minerals predominate, compounds not found in the earth's crust such as certain carbides, phosphides and nitrides have been uncovered in meteorites. The 1418 specimens in the Hungarian collections contain 782 chondrites with increased Fe content, and also considerable amounts of O, Na, Mg, Al, and Si. Although the specimens have a heterogeneous structure their gross average composition is surprisingly uniform. The relative abundance data must be handled with great care in drawing cosmochemical conclusions because Fe and similar resistant elements have a greater probability of reaching the surface of the earth than certain other elements. Current results seem to indicate that the meteorites originate in the solar system from a planet with a lower (3.7 to 4) density than that of the earth. (TTT)

15878 PLANNED INVESTIGATIONS OF THE ATOMIC RESEARCH INSTITUTE OF THE HUNGARIAN ACADEMY OF SCIENCES IN DEBRECEN ON THE FIELD OF METEORITE RESEARCH. Sándor Szalay. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen). Közlemények, 2: 205-6(1960). (In Hungarian)

Investigation of the universe by means of rockets entails such high expenses that only the two most powerful countries are able to pursue it. However, large quantities of "samples" from the space are received on the earth in the form of meteorites and meteorite dust. These materials have not yet been studied by modern methods. It was decided to take advantage of this "free gift of nature" and the Atomic Research Institute of Debrecen will undertake a systematic mass-spectrographic investigation of the meteorites available in the Hungarian museums, with special attention to the determination of their age. A close liaison will be maintained with the work in progress at the I. V. Vernadskiĭ Geochemical Research Institute in Moscow. It is anticipated that the determination of the He^3/He^4 ratio which according to foreign data is shifted in comparison with ratio on the earth, might yield interesting results. (TTT)

15879 THE METEOROLOGICAL TOWER OF THE C.N.R.N. OF ISPRA. L. Santomauro (C.N.R.N., Ispra, Italy). Minerva med., 3: No. 2, 57-60(Feb. 1959). (CNI-74). (In Italian)

The criteria adopted in the meteoric equipment of the Centre for Nuclear Researches of Ispra and the meteorological tower constructed are described, as well as the equipment contained. (auth)

15880 RADIOACTIVE DATING OF TERTIARY PLANT-BEARING DEPOSITS. Glenn E. Rouse and W. H. Mathews (Univ. of British Columbia, Vancouver). Science, 133: 1079-80(Apr. 7, 1961).

Four potassium-argon determinations from Tertiary rocks in the interior of British Columbia have yielded dates ranging from 45 to 49 million years. This suggests contemporaneity of three separate localities within the Middle Eocene epoch. Abundant plant micro- and macrofossils support this conclusion and indicate a flora quite different from floras of comparable age in western United States. (auth)

15881 MEASUREMENTS OF NATURAL RADIOACTIVITY AT CAGLIARI IN RELATION TO WIND AND ATMOSPHERIC PRECIPITATIONS. N. Mattana, S. Sanna, and A. Serra (Osservatorio Scientifico Sperimentale di Meteorologia Aeronautica, Cagliari, Italy). Riv. meteorol. aeronaut., 21: No. 2, 5-27(Apr.-June 1961). (In Italian)

The standard equipment used consists of a pump, a flow meter, filters, and a G.M. counter. Beta activity due mostly to radon, thoron, and actinon are measured. It is found that the concentrations of radon and thoron are inversely proportional to the velocity of the wind and the rainfall. A formula giving the variations of the concentrations (C) of radioactive particles, due to wind velocity (v) is derived: $C = C_0 \cdot e^{-(av+(b/v))}$, where C_0 is the concentration in still air, v the wind velocity, a and b are two factors depending on local conditions. Other measurements will be made to take into account the thermal gradient of the atmosphere. (EURATOM)

15882 THE USE OF AN EXPERIMENTAL DEVICE FOR THE DETERMINATION OF THE CONCENTRATION OF ARTIFICIAL RADIOACTIVE AEROSOLS AT HIGH ALTITUDES. D. Boclet (Centre d'Etudes Nucleaires, Saclay, France). C. Jehanno, J. Labeyrie, and H. Le Boiteux. p.215-20 of "Space Research. Proceedings of the First International Space Science Symposium, held at Nice, January 11-16, 1960." H. K. Kallmann Bijl, ed. Amsterdam, North-Holland Publishing Co., 1960. (CEA-1773). (In French)

From measurements with a Geiger counter on January 27, 1959 at an altitude reaching 65 km at the geomagnetic latitude (41° North), it is concluded that radioactive aerosols above Southern France tropopause had a concentration less than 100×10^{-12} c/m^3. The missile used for this purpose and its performance are described. (auth)

15883 AREAL GEOLOGY OF THE LITTLE CONE QUADRANGLE COLORADO. A. L. Bush, O. T. Marsh, and R. B. Taylor (Geological Survey, Washington, D. C.). Geological Survey Bulletin 1082-G. 1960. 74p., 2 illus.

15884 PETROLOGY OF THE MEADE PEAK PHOSPHATIC SHALE MEMBER OF THE PHOSPHORIA FORMATION AT COAL CANYON, WYOMING AND A METHOD OF X-RAY ANALYSIS FOR DETERMINING THE RATIO OF CALCITE TO DOLOMITE IN MINERAL MIXTURES. R. A. Gulbrandsen (Geological Survey, Washington, D. C.). Geological Survey Bulletin 1111-C,D. 1960. 90p., 2 illus.

Part 1. The Coal Canyon, western Wyoming, section of the Meade Peak phosphatic shale member of the Phosphoria formation is located about 20 miles southeast of the type locality of the Meade Peak member and within the region in which the Meade Peak is characteristically developed. The member is 143 ft thick at Coal Canyon and consists of dark thin-bedded phosphorites and carbonate and quartz-silicate rocks. The rocks of the section were studied in detail with particular emphasis upon the characteristics of the phosphorites and carbonate rocks and their modes of formation. Results are presented in detail. (C.H.)

Part 2. The use of x-ray methods for determining the proportion of calcite to dolomite in carbonate rocks is apparently not common. Accordingly, an experiment was designed to test the usefulness of x-ray diffraction intensities of calcite and dolomite as a means of estimating the percentage ratio of these minerals in carbonate rocks of the Meade Peak phosphatic shale member of Coal Canyon, Wyo. X-ray analyses were made of 16 prepared mineral mixtures of a known composition that was similar to that of the carbonate rocks of the phosphatic shale member. The analyses indicate that the differences between the peak heights of calcite and dolomite are due to differences in amounts of calcite and dolomite, and that the ratios of the peak heights are useful as a measure of the ratios of calcite to dolomite. (auth)

15885 PRELIMINARY GEOLOGIC MAP OF THE EMMETT WASH NW QUADRANGLE, COCONINO COUNTY, ARIZONA. Richard G. Petersen and John D. Wells (Geological Survey. Washington, D. C.). Mineral Investigations Field Studies Map MF-197. 1961. 1p.

15886 URANIUM AND OTHER TRACE ELEMENTS IN PETROLEUMS AND ROCK ASPHALTS. Kenneth G. Bell (Geological Survey, Washington, D. C.). Geological Survey Professional Paper 356-B. 1960. 64p., 4 illus.

Uranium is a minor trace-element constituent of petroleums and their natural derivatives. The quantity of uranium in crude oils produced by primary-recovery processes generally ranges from none to 5 ppb although some crude oils may contain as much as a few tens of parts per billion. The average uranium content for all crude oil is estimated to be about 1 ppb, or about one-third that of the average content of sea water. Paraffin-base crude oils have the smallest uranium content, less than 1 ppb. Mixed-base and asphalt-base crude oils, in general, contain a slightly greater quantity of uranium and show a rough positive correlation between specific gravity and uranium content. There is no correlation between uranium contents of crude oils and geologic ages of reservoir rocks. Crude oils from one region are no more uraniferous than those from any other, except perhaps as a result of local predominance of heavy aromatic and asphaltic constituents. As a group, the crude oils of the Colorado Plateau and Rocky Mountain regions, both being uraniferous provinces, contain less-than-average quantities of uranium, a condition that is attributed to predominance of paraffinic constituents. Crude oils produced by secondary-recovery processes utilizing water flooding and detergents apparently contain above-average quantities of uranium, possibly because they contain asphaltic residues that are removed from pore walls of reservoir rocks. The mode of occurrence of uranium in petroliferous materials and the source of the uranium have not been determined. The bituminous constituents of rock asphalts contain as much as a few thousand parts per billion of uranium, the average being about 1000 ppb, a concentration that is about a thousand-fold increase over than in crude oils and probably a somewhat smaller increase over that in petroleums. It is believed that the bitumens extract uranium from the host rocks. There seems to be a positive correlation between the uranium content of the bitumens and that of the host rocks. There is no evidence that petroleum acts as an ore-forming fluid for uranium. Oil field waters containing dissolved organic substances extracted from petroleum, and hydrogen sulfide, may provide a reducing environment in which uranium brought in by ground water or hydrothermal solutions may be precipitated at the interface of the solutions. Crude oil is not a practical source material for uranium; the total uranium content of the crude oil reserves of the United States does not exceed 5 tons. The bitumens of the rock-asphalt deposits of the United States contain several hundred tons of uranium, but, because these bitumens are dispersed in several billion tons of rock, they are not practical source materials for uranium. (auth)

15887 JOINTS IN PRECAMBRIAN ROCKS, CENTRAL CITY-IDAHO SPRINGS AREA, COLORADO. J. E. Harrison and R. H. Moench (Geological Survey, Washington, D. C.). Geological Survey Professional Paper 374-B. 1961. 17p.

Attitudes of about 9000 joints in Precambrian intrusive and metasedimentary rocks in the 50-square-mile area studied reveal that some joints sets are systematically distributed. Each of the principal Precambrian intrusive masses contains primary joints. Joints related to folds have formed during two periods of Precambrian deformation and probably during Laramide arching of the Front Range. A time sequence of geologic events and jointing can be worked out as follows: First, granodiorite was intruded during the older Precambrian deformation; primary joints formed in the granodiorite, and joints related to sinuous and doubly plunging folds formed in the metasedimentary rocks. Second, biotite-muscovite granite was intruded late in an older period of Precambrian deformation; primary joints formed in the granite. Third, Precambrian metamorphic and igneous rocks were locally deformed during a younger period of Precambrian folding; joints related to this folding formed in all Precambrian rocks, and a unique set of slickensided joints formed predominantly in the more massive granitic rocks. Fourth, a system of four joint sets was formed that locally cuts Precambrian rocks but not the Tertiary rocks that intrude them. Joints of this system were locally followed by Tertiary dikes, and therefore can be dated in outcrop only as post-Precambrian but pre-Tertiary. The conformity of the system with that expected from arching of the Front Range highland leads us to conclude that the post-Precambrian system probably is Laramide in age. (auth)

HEALTH AND SAFETY

15888 (A/AC.82/G/L.413) BIOLOGICHESKAYA OPASNOST OT POVYSHENIYA KONTSENTRATSII C14 V REZUL'TATE VZRYVOV YADERNYKH BOMB. (The Biological Hazard from Increased C-14 Concentration Resulting from Nuclear Bomb Explosions). A. M. Kuzin (Akademiya Nauk S.S.S.R.). 1960. 8p.

An analysis is made of data on the anticipated biological effects of C^{14} as compared to K^{40}. The data indicate that increased exposure, especially exposure of gonad cells, to C^{14} produces stronger genetic effects than has been reported. The data indicate C^{14} is 10 to 20 times more effective genetically than an equivalent external radiation. Consequently, nuclear explosions at the 1958 rate will contaminate the atmosphere with C^{14} to such an extent that a million children with heavy genetic injuries would be born in the next 30 years. (R.V.J.)

15889 (AF-SAM-60-55) DOSIMETRY AND TECHNIC FOR THE IRRADIATION OF BIOLOGIC SAMPLES WITH HEAVY IONS. Franklin Hutchinson (Yale Univ., New Haven). Dec. 1960. 6p.

Samples to be irradiated are put on glass disks and rotated one at a time into the beam. Dosimetry is usually carried out by using an electrometer to measure the total charge collected within the Faraday chamber. If the currents are 10^{-8} amp or greater they may be measured on a galvanometer, and the dose determined by the product of current and time of exposure. (C.H.)

15890 (AHSB(RP)R-7) CALCULATIONS OF THE MAXIMUM PERMISSIBLE CONCENTRATIONS IN AIR AND WATER OF CERTAIN FISSION PRODUCT MIXTURES. S. A. Beach (United Kingdom Atomic Energy Authority. Authority Health and Safety Branch. Radiological Protection Div., Harwell, Berks, England). Jan. 1961. 15p.

The activity of each separate fission product, as it occurs in a fuel element, was calculated for an arbitrarily selected irradiation time of 300 days in a thermal fission reactor and for decay times of 1, 10, 100, and 1000 days. The maximum permissible concentrations in air and water of the resultant fission product mixtures were then computed and the results presented graphically for varying periods of decay. These calculations suggested that, with the assumptions detailed, the values 1.0×10^{-9} μc/cc $(MPC)_a$ and 2.0×10^{-5} μc/cc $(MPC)_w$ be used for continuous occupational exposure during a 40 hour week. (auth)

15891 (APAE-84) HAZARDS REPORT FOR THE SM-1 CORE II WITH SPECIAL COMPONENTS. J. Coombe, D. Lee, I. Segalman, and R. Robertson (Alco Products, Inc., Schenectady, N. Y.). Mar. 30, 1961. Contract AT(30-1)-2639. 48p.

The changes incurred in the SM-1 by the insertion of the SM-1 Core II and special components are described. The special components consist of impact specimens, a boron gradient rod, SM-2 elements, a PM-1-M element, and high burnup SM-1 Core I elements. An analysis indicated that there was no change in hazards due to operation with Core II and the special components. (auth)

15892 (FFIS-IR-S-03) FALLOUT IN NORWEGIAN MILK IN 1959. H. Bergh, G. Finstad, T. Hvinden, A. Lillegraven, L. Lund, and O. Michelsen (Norway. Forsvarets Forskningsinstitutt, Kjeller). Dec. 7, 1960. 11p.

Weekly samples from three localities were analyzed. Sampling and analytical procedures are described. (C.H.)

15893 (IDO-12014) ANNUAL REPORT OF THE HEALTH AND SAFETY DIVISION, 1959. (Idaho Operations Office. Health and Safety Div., AEC). Oct. 1960. 193p.

During 1959 the National Reactor Testing Station had one fatality and 19 disabling injuries; radiation exposure of 2462 rem to employees; 6000 c of short and intermediate half life material discharged as liquid waste to the soil; 23,000 c of intermediate to long half life material consigned to the burial ground; and atmospheric dissipation of approximately 200,000 c of short half life effluents. An active physical and biological monitoring program was carried out. Samples of air, water, soil, milk, vegetation, animal organs, and bones were analyzed for radioactivity. Data are tabulated. One-hundred-thirty thousand film badges were processed and 11,000 samples of urine were analyzed for radioactive and other toxic materials. An inexpensive personnel neutron threshold detector was incorporated in every film badge, a Safety and Fire Protection Design Criteria Manual was published, and effluent and alert disaster planning received increased emphasis. Data are included from research studies related to underground disposal of water, changes or trends in the water regimen, and studies of hydrologic conditions. Results are also included from studies on atmospheric diffusion and transport. (C.H.)

15894 (LAMS-2514) CONSEQUENCES OF THE INHALATION OF INSOLUBLE PARTICULATE MATERIAL CONTAINING AN HYDROLYZABLE RADIONUCLIDE. Harvey I. Israel (Los Alamos Scientific Lab., N. Mex.). Dec. 1960. Contract W-7405-ENG-36. 11p.

A theoretical study was made of body activity to be expected following the inhalation of an insoluble particulate containing a hydrolyzable nuclide. Expressions were derived for daily urinary excretion rate and body burden as a function of time after inhalation. (auth)

15895 (MND-2410) RADIOACTIVE MATERIALS LABORATORY SAFETY REPORT, MARTIN NUCLEAR FACILITY, QUEHANNA SITE. (Martin Co. Nuclear Div., Baltimore). Sept. 1960. 191p.

A description is given of the safety features and the major alterations to be performed prior to occupancy. The evaluation was made in support of fabrication work on the production of safe isotopic power sources from Cm^{242} and Sr^{90}. The chemical, nuclear, and radiobiological properties of Cm^{242} and Sr^{90} are outlined. The projected physical flow of materials for production of the isotopic power sources is schematically given. An evaluation of the malfunctions, operational hazards, and remedial health physics procedures is presented. The analysis and evaluation of postulated maximum credible incidents are demonstrated. (B.O.G.)

15896 (NP-9933) MODEL STUDIES OF BLAST EFFECTS. VII. ENTRY OF BLAST INTO THE HOUSEHOLD BASEMENT FALLOUT SHELTER. Suffield Technical Pa-

per No. 215. J. C. Muirhead (Canada. Suffield Experimental Station, Ralston, Alberta). Jan. 17, 1961. 46p.

Shock tube experiments are described in which a model household basement fall-out shelter was exposed to shock waves having overpressures of approximately 5 psi. Shadow and Schlieren photographs of the resulting movement of a smoke stream and of the wave system in the shelter are given. It is concluded that the present geometrical design of the household basement fall-out shelter can give a useful degree of protection against the effects of blast waves, provided that it can be made with sufficient physical strength to be at least as resistant to collapse as the rest of the basement. (auth)

15897 (NP-9947) PRELIMINARY HAZARDS SUMMARY, MOCK-UP REACTOR, NASA PLUM BROOK REACTOR FACILITY. Patrick M. Finnegan (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Jan. 1961. 126p.

A preliminary safeguards and hazards summary for the Plum Brook Mock-Up Reactor (MUR) is presented. The layouts of the core and MUR and experimental facilities of the low-power, highly enriched, water cooled and moderated, beryllium-water reflected reactor are shown. A typical new fuel assembly will contain about 168 g of U^{235}. A typical new control rod fuel assembly will contain approximately 130 g of U^{235}. The static characteristics of the reactor are given. The reactor core will be submerged in a demineralized light-water pool. The control rod assembly and the drive system are shown schematically. Two individually operated regulating rods are provided. Eight shim-safety rods, 3 in the reflection region and 5 in the fuel region, are also provided. The control and safety system consists of 5 separate channels, 2 power level safety channels, one period safety channel, and two startup channels. The power cutback system was designed to detect a potentially hazardous condition and to select, from 3 modes of corrective action, one that would cause the control or safety system to start correcting at a rate determined by the degree of hazard involved. The abnormal conditions and the corrective action are given. General safety procedures are discussed. The MUR was designed to self-regulate excursions due to reactivity insertions up to 2.5% without damaging the reactor or producing a significant personnel radiation hazard. The credible accidents associated with MUR operations were analyzed and it was concluded that the maximum credible accident would be caused by the insertion of one dollar's worth of reactivity. (M.C.G.)

15898 (NP-9992) SHORT WAVE ELECTROMAGNETIC RADIATION AS A HAZARD TO PERSONNEL. Lecture and Review Series No. 60-6. David E. Goldman (Naval Medical Research Inst., Bethesda, Md.). Sept. 17, 1960. 8p.

The radiation hazards of short-wave electromagnetic radiation are discussed. It is pointed out that electromagnetic radiation produces electrical and magnetic forces and generates heat upon contact with biological systems. Reactions are induced which are potentially dangerous to animals. Reported cases of eye damage and other serious injuries to personnel working with high powered radar generators are discussed. Results are reported from studies with monkeys in which a number of neurological disturbances were induced by exposure to radio frequencies in the 300 to 400 Mc range. Results of other animal studies are discussed briefly, and reaction mechanisms involved in the biological effects of primary radiations in the range 100 to 30,000 Mc are summarized. Data are tabulated from measurements of the conductivity and dielectric constant of skin; the dielectric constant of selected tissues; the percent energy absorption by whole rats, rabbits, and dogs; and the cooling time constant for mice, rats, rabbits, dogs, and humans exposed to radiations in this energy range. Data are also included on the heat input and output of the body at various temperatures under steady state conditions. (C.H.)

15899 (NP-10007) TRAINING IN RADIOLOGICAL HEALTH AND SAFETY. Report of a Committee appointed by the United Kingdom Atomic Energy Authority. (United Kingdom Atomic Energy Authority. Committee on Training in Health and Safety, London). Feb. 1960. 95p.

The status is reviewed of training programs in radiological health and safety in the United Kingdom. Results are reported from a survey on the duties and probable number of those for whom such training is required; the training courses already provided; and the courses likely to be needed to meet the demand at different levels. Recommendations for future training courses are presented. (C.H.)

15900 (NP-10014) GUIDEBOOK FOR THE PLANNING OF INTEGRATED ATOMIC DEFENSE SHELTERS IN SELECTED MILITARY BUILDING TYPES. Gifford H. Albright, Allen F. Dill, Rolv O. Enge, Anthony H. Foderaro, Walter H. Hill, Melvin W. Isenberg, Lester L. Boyer, William A. Jester, and Roger H. Kaness (Pennsylvania State Univ., University Park. Coll. of Engineering and Architecture). Feb. 1961. Contract NBy-3188. 194p.

This guidebook presents, in terms understood by architects and planners, information to enable such professionals to effectively plan integrated shelter as a part of the design of selected military building types. The basic principles of the philosophy of protection, the philosophy of integrated convertible shelters, weapons effects, and architectural planning considerations are presented as background for the planning analyses and concepts for the integrated convertible shelters in several selected military building types. This guidebook illustrates the point that integrated convertible shelters can be incorporated within conventional spaces of buildings without decreasing the efficiency of performing the normal functions. The military building types selected to illustrate the planning analyses and concepts are: Enlisted Man's Barracks, Training School, Administration Building, 100 Bed Hospital, Subsistence Building, and a Communications Building. (auth)

15901 (NP-10032) SHIELDING FACTORS FOR UNDERGROUND SHELTERS OF VARIOUS GEOMETRIC SHAPES. Technical Report No. 080. J. C. LeDoux and L. K. Donovan (Naval Civil Engineering Lab., Port Hueneme, Calif.). Apr. 5, 1961. 49p.

A study was made of the additional nuclear shielding from an isotropic radioactive gamma source afforded by various shapes of underground curved-roof shelters compared to the basic slab shield. Curves are presented from which the geometry factors for spheres, ellipsoids, and horizontal and vertical cylinders can be obtained with minimum calculations by using only the dimensions of the shelter and the depth of material above the crown. (auth)

15902 (NP-10069) DETERMINATION OF NEUTRON DOSAGES BY FOOD IRRADIATION DEVICES. Report No. 12 (Final), September 10, 1956—May 9, 1960. P. Kruger (Nuclear Science and Engineering Corp., Pittsburgh). Contract Da-19-129-QM-741. 120p.

Measurements were made of neutron fluxes present in several types of food irradiation facilities using spent fuel elements, Co^{60}, and linear accelerators as sources. Flux

measurements were made in thermal, epithermal, and fast neutron energy ranges. Measurements were also made of induced radioactivities in foods exposed to sterilizing doses of radiation. To measure the induced activity in sterilized foods, absolute counting was done on representative samples of irradiated foods and compared to the activity levels of naturally occurring K^{40}. The contribution to the total activity level by the naturally occurring and fall-out radioisotopes was determined. (C.H.)

15903 (ORNL-2748(Pt.B)) RADIATION ACCIDENTS: MEDICAL ASPECTS OF NEUTRON AND GAMMA-RAY EXPOSURES. N. Wald and G. E. Thoma, Jr. (Oak Ridge National Lab., Tenn.). Mar. 8, 1961. Contract W-7405-eng-26. 177p.

During the 20-year development of nuclear technology there have been 7 major accidents involving significant overexposures of 32 people to ionizing radiation. A chronological list of these accidents is presented, and data are tabulated on exposure dose of each individual. All presently available data concerning human exposure to neutrons and gamma radiation in criticality accidents are reviewed in developing procedures for the future clinical management of radiation exposure cases. Present information provides the basis for establishment of five categories of injury in increasing order of severity. A hypothetical case history of a typical patient in each of the five groups is described. The clinical laboratory findings associated with each clinical group are analyzed, and the predictive value of certain early laboratory tests as an indicator of the extent of clinical injury are discussed. Recommendations for diagnostic procedures in radiation injury, as well as its therapeutic management, are made on the basis of past experience. The relationship between clinical and laboratory evidences of injury and the exposure dose which produced them are analyzed. Recommendations for the clinical management of patients in each group are made on the basis of results from past experiences. On the basis of available data, it is concluded that about 15% of people exposed to a dose of 100 rads may be expected to show the signs and symptoms of the radiation syndrome, and the frequency will increase sharply up to the level of approximately 200 rads. Death did not occur in any of the treated patients with known doses of less than 500 rads. A fatal outcome appears likely at a dose level above 800 rads. These generalizations will be influenced by the mixture of various radiations which comprise the exposure dose. The LD_{50} for man is impossible to estimate accurately on the basis of the small amount of data available. 22 references. (C.H.)

15904 (ORNL-3073) APPLIED HEALTH PHYSICS ANNUAL REPORT FOR 1959. (Oak Ridge National Lab., Tenn.). Mar. 27, 1961. Contract W-7405-eng-26. 39p.

Area Monitoring. The average air contamination levels for the Laboratory, perimeter, and remote areas were 0.4, 1.6, and 1.4%, respectively, of the maximum permissible concentration (MPC). Analysis of the higher levels observed during the first part of the year indicated that they were due to radioactive fall-out. The probable average concentration of mixed fission products in the Clinch River were 3.1×10^{-7} and 4.9×10^{-8} μc/cc at Mile 20.8 (point of entry of wastes) and Mile 4.5 (Kingston, Tenn.), respectively; these values are 25.4 and 22.3% of the weighted average MPC. The river MPC, however, was exceeded three weeks during the year, the first two instances resulting from heavy rains which scoured the White Oak Creek drainage basin and the third instance resulting from dilution loss in the river due to a below-normal river flow. Silt monitoring showed that the gamma count rate in the river increased sharply immediately downstream from the point of entry of the wastes, peaking at Mile 16.3. Other local rises of water activity levels are discussed. The average radiation background in the Laboratory and perimeter areas was 0.13 and 0.02 mr/hr, respectively. Personnel Monitoring. No personnel exposures exceeded NBS handbook limits. The highest total personnel dose was ~9 rem, or 75% of the MP annual dose of 12 rem, and only one individual had accumulated a total dose exceeding the age proration formulas, mostly due to a 1957 accident. Three major contamination events occurred in Oct. and Nov. 1959 and involved equipment failure. The first event resulted in a release of Ru^{106} through process waste lines to the waste treatment plant via a heat exchanger leak, and special control measures were taken to prevent exceeding the MPC in the Clinch River due to the event. The second event resulted in distribution of Ru^{106} particulates over a large protion of the Laboratory area due to short test operations of a fan at the base of an off-gas stack. The third event resulted in plutonium contamination of several buildings from an explosion in a chemical processing plant. No personnel exposures above MP levels resulted from these three events. Minor contamination events are also discussed. (D.L.C.)

15905 (ORO-359) TIME EXPOSURE PHOTOGRAPHY OF SMOKE PLUMES. Walter M. Culkowski (Weather Bureau, Oak Ridge, Tenn.). [1961]. 20p.

Techniques are described for making long-time exposure photographs of smoke plumes for use in studies on atmospheric diffusion and air pollution. Exposures were made over periods of time extending up to 9 hrs. Ten photographs illustrate the methods used. (C.H.)

15906 (RAE-TN-MS-70) THE ASSESSMENT OF RADIATION DOSES AND BLAST CASUALTIES FROM NUCLEAR ATTACKS. K. N. Dodd (Gt. Brit. Royal Aircraft Establishment, Farnborough, Hants, England). Sept. 1960.

Mathematical expressions are presented for use in the Deuce computer for computing the radiation dose and blast casualties resulting from blast and fall-out from a nuclear attack. A series of explosions at various points and various degrees of protection for the population are assumed. Various factors affecting the movement of a radioactive cloud are considered. (C.H.)

15907 (SC-4357A(RR)) HAZARDS EVALUATION OF THE SANDIA PULSED REACTOR FACILITY (SPRF). P. D. O'Brien (Sandia Corp., Albuquerque, N. Mex.). Feb. 1961. Contract AT(29-1)-789. 48p.

A description is given of the design and operation of the Sandia Pulsed Reactor Facility, a radiation facility to be used in conjunction with a radiation effects testing program. The safety of the facility is analyzed with respect to the credibility and consequences of hypothetical reactor accidents. The evaluation of the hazards associated with operation of the reactor leads to the conclusion that the facility can fulfill its intended function without compromising public health or safety. (auth)

15908 (SC-4547(RR)) KDB-1 LOW-LEVEL AIRCRAFT SAMPLING SYSTEM. H. J. Plagge (Sandia Corp., Albuquerque, N. Mex.). Mar. 1961. Contract AT(29-1)-789. 14p.

Use of KDB-1 drone aircraft appears feasible for the sampling of atomic debris at altitudes from 1000 to 40,000 feet. Further development would be necessary for precision control below 1000 feet. Further development and testing remains to be done on the sampling devices before the system can become operational. This system would be approximately one-seventh as expensive as present systems using manned aircraft. (auth)

15909 (USNRDL-TR-502) PRELIMINARY REPORT ON THE SHELTER OCCUPANCY TEST OF 25-29 JULY 1960. W. E. Strope, D. P. Schultze, and J. I. Pond (Naval Radiological Defense Lab., San Francisco). Mar. 21, 1961. 57p.

The USNRDL experimental shelter at Camp Parks, California, was occupied continually by 100 male volunteers for a period of 100 hours under summer conditions of outside air temperature. During this period, all aspects of the shelter environment were monitored, as well as the actions and responses of the shelterees. Modifications to shelter facilities were tested, the palatability of and preparation procedures for an experimental shelter diet were evaluated, and additional experience in shelter management was obtained. This is a preliminary report made in advance of complete analysis of the data. (auth)

15910 (WT-1194) DAMAGE TO CONVENTIONAL AND SPECIAL TYPES OF RESIDENCES EXPOSED TO NUCLEAR EFFECTS. Philip A. Randall (Office of Civil and Defense Mobilization, Washington, D. C., Housing and Home Finance Agency, Washington, D. C., and Federal Housing Administration, Washington, D. C.). Mar. 1961. Project 31.1 [of] OPERATION TEAPOT. 82p.

Ten residential structures of wood, brick, lightweight reinforced concrete block, and lightweight precast concrete slabs were exposed in pairs to the effects of a nuclear device of approximately 30 kt yield, detonated atop a 500-ft tower. The houses represented various structural types, and two houses of each type were tested. One house was located at an anticipated overpressure at which collapse or major damage might be expected and the other was located at an anticipated overpressure at which damage without collapse might be expected. The one-story reinforced lightweight concrete block house and the one-story precast lightweight concrete house suffered only minor structural damage. Photographs are included of the houses both before and after damage. Motion pictures were made during the event and were analyzed for information on thermal and blast effects. Recommendations are included for strengthening the structures within the limits of practical economy and so providing increased protection to dwelling structures. (C.H.)

15911 (AEC-tr-4552) CONTRIBUTION TO THE STUDY OF EXTERNAL DECONTAMINATION PROCEDURE EXPERIMENTATION ON A NEW PRODUCT IN THE CASE OF RADIOACTIVE CONTAMINATION OF TEGUMENTS. J. Toulet and J. Tabernat. Translated from Arch. maladies profess. méd. travail et sécurité sociale, 20: 272-82(1959). 14p.

Also issued as French report CEA-1289.

Problems involved in the decontamination of the skin of radioactive materials are reviewed. Factors affecting the effectiveness of decontaminating solutions are discussed. An evaluation was made of the effectiveness of 20 different products for skin decontamination. It was found that several short applications of each of several decontaminating agents, followed by rinsing, gave better results than prolonged application of one agent. Preliminary results are reported from laboratory and clinical tests of the effectiveness of M.O.8.385 lotion, which consists of natural mineral water modified by the addition of certain vegatable oils. The composition of this lotion is given and reaction mechanisms involved in its decontaminating action are discussed. (C.H.)

15912 (JPRS-7886(p.94-100)) METHOD OF SIMULTANEOUS CONTROL OF SURFACE POLLUTION BY α- AND β-ACTIVE SUBSTANCES. I. B. Keirim-Markus, V. V. Markelov, and L. N. Uspenskii (Uspenskiy). Translated from Med. Radiol., 5: No. 10, 68-72(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 6293.

15913 PHYSICAL BASES OF RADIOBIOLOGICAL EXPERIMENTS WITH NEUTRON FLUXES. B. M. Isayev (Inst. of Biological Physics, Academy of Sciences, Moscow). Biophysics (U.S.S.R.)(English Translation), 5: No. 4, 543-55(1960).

Problems associated with measurements of the relative biological effectiveness of neutron fluxes of different energies are discussed. Procedures are described for the dosimetry of neutrons with energies below 20 Mev. It is pointed out that the number and character of nuclear reactions in tissue are determined by the chemical composition of the tissue. Reactions in normal tissue, and tissue with artificially introduced B^{10}, are described. Expression of the dose absorbed in rads or ergs implies determination of the total energy of the ionizing radiation absorbed by the irradiated substance per unit mass. Calculation of the absorbed dose is only the first step in dosimetry, and the absorbed dose must be defined in relation to the linear energy density of the absorbed energy. The material presented suggests that in each particular case involving neutron fluxes, very extensive dosimetric measurements should be made to determine the absorbed dose at different points of the irradiated object for the various ionizing components. Use should be made of threshold detectors, ionization, photographic, and chemical methods of dosimetry. (C.H.)

15914 RAPID AND ACCURATE ASSESSMENT OF SAFE CONDITIONS FOR HANDLING RADIOACTIVE SOURCES. Jiří Simerda and Jan Hekrdle. Jaderná energie, 7: 43-7(Feb. 1961). (In Czech.)

A special sliding rule, which may be used for rapid determination of safe conditions for handling ionizing radiation sources, is described. This rule is used for the calculation of necessary shielding from any radioisotope using different shielding materials, even in the case of broad γ radiation beams. (auth)

15915 RADIODIAGNOSTIC PATIENT DOSE OR RADIATION DOSE THE PATIENT IS EXPOSED TO. Werner Lorenz (Johannes Gutenberg Universität, Mainz). Röntgen Bl., 14: 84-9(Mar. 1961). (In German)

It is shown that the quantity of x rays absorbed by the body of the patient over a wide radiodiagnostic range is actually biologically so limited that in such cases it appears more appropriate to speak of an exposure of the patient to radiation, while the generally applied term radiation load or dose should only be employed whenever, in all practically significant probability, the absorbed quantity of rays constitutes a definite biological danger. (auth)

15916 FALLOUT RADIOACTIVITY IN CATTLE AND ITS EFFECTS. M. A. Van Dilla (Los Alamos Scientific Lab., N. Mex.), G. R. Farmer, and V. R. Bohman. Science, 133: 1075-7(Apr. 7, 1961).

The levels of Sr^{90} amd Cs^{137} in cattle grazed on the Nevada Test Site and elsewhere in Nevada are similar to those in cattle from other parts of the country. Gastrointestinal absorption of the relatively large amounts of radioactive Ce–Pr, Ru–Rh, and Nb–Zr present in the rumina is very small. Zn^{65} made its first appearance in samples of muscle and liver in November 1958 and has persisted in later samplings. There has been no evidence of biological damage to date, either histologically or grossly (auth)

15917 FALLOUT FROM NUCLEAR DETONATIONS OF FEBRUARY AND APRIL 1960. P. K. Kuroda, H. L. Hodges, and H. E. Moore (Univ. of Arkansas, Fayetteville). Science, 133: 1130-1(Apr. 14, 1961).

A sharp increase in the ratio of Sr^{89} to Sr^{90} in rain was observed in Fayetteville, Arkansas, after the French nuclear detonations of February and April 1960. Experimental data obtained suggest the possibility that part of the debris from atom bombs detonated in the tropical region may enter the stratosphere. (auth)

15918 ELECTRON MICROSCOPY AND AUTORADIOGRAPHY. L. A. George, II (General Electric Co., Richland, Wash.). Science, 133: 1423-4(May 5, 1961). (HW-SA-2055)

The combined techniques of electron microscopy and autoradiography were used for the purpose of differentiating radioactive from nonradioactive particles collected on membrane filters. Newer methods of processing the membrane filters and applying the nuclear emulsion have resulted in an improvement in the qualitative nature of the procedure. (auth)

15919 MANUFACTURE OF MULTILAYER MATERIAL FOR PROTECTION AGAINST RADIOACTIVE WASTE. Wilhelm Ernst (to Papierfabrik Wilhelmstal). Belgian Patent 570,788. Feb. 28, 1959. (In French)

The protective wrapping or cover is composed of a fibrous absorbent; a layer of adhesive material such as wax, bitumen, or thermoplastic polymers; and a layer of rigid paper, metal, or plastic material. This composite material is used for protection of walls and equipment, handling of radioactive waste, and manufacture of protective clothing. (EURATOM)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

15920 (CEA-1783) LES PROBLEMES DE SECURITE DANS L'EMPLOI DE SOURCES RADIOACTIVES POUR L'ETUDE DE L'USURE DES REVETEMENTS REFRACTAIRES. (Safety Problems Arising from the Use of Radioactive Sources in the Study of the Wear in Refractory Linings). G. Courtois, R. Hours, P. Le Clerc, and A. Pons (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1960. 19p.

The determination of the wear in refractories is a problem to which there are at present only a few solutions. The use of radioactive tracers contained in the refractory has met with rapid success. Unfortunately, the development of the method has been retarded by the need to limit severely the amounts of radioelement incorporated and also by the observation that diffusion of the Co^{60} occurred in the refractory. As a result, the limiting amount of 1 mc of Co^{60} per 500 metric tons of cast iron has been adopted in France, with the proviso that no single source exceeds 3 mc. Further, special sources were made with a view to avoiding diffusion phenomena. The essential feature of these sources is that they use pyroceramic, a nonporous material having a high melting point and being very inert chemically. In these sources, the radioelement can either be entirely encased in the pyroceramic or be an integral part of its composition. A comparative study of the two types of sources is under way. (auth)

15921 (NP-10004) APPLICATIONS INDUSTRIELLES DES RADIO-ELEMENTS. (Industrial Application of Radioelements). Alain Sola (Caisse Nationale des Marchés de l'État, Paris). Nov. 30, 1959. 61p.

A survey is made of the uses of radioisotopes, and the results are related to the French program. The fields of isotope use examined are food, agriculture, medicine and pharmacy, and industry. The economies realized in other countries through isotope applications are pointed out, and the development programs of the US and Great Britain are described. Appendices are included on radioisotope use classified by industry, principal industrial uses, and tables of economies realized in the US for 1957/58. (T.R.H.)

15922 (NYO-2505) THE TECHNOLOGY AND APPLICATIONS OF LARGE FISSION PRODUCT BETA SOURCES. Quarterly Report for the Period January 1 to April 1, 1961. Jacques J. Weinstock, E. Y. Microcznik, and K. D. Ziegel (Radiation Applications Inc., Long Island City, N. Y.). Apr. 13, 1961. Contract AT(30-1)-2186. 9p.

A testing program was established to evaluate the corrosion, handling, and durability properties of vitreous enamel beta sources. Appropriate pieces of apparatus were fabricated and existing equipment was modified in order to perform the desired tests. Experiments were performed on the deposition of enamel frit from a water slurry. Initial results indicate this method may be an improvement over previous methods. Deposition from a water slurry should be particularly effective in reducing the potential hazard (or problem) of dispersion of radioactive powder during the fabrication of these sources. The fabrication of planar enamel sources supported by wire mesh is currently being studied in an effort to reduce the absorption of beta particles by the metal substrate. Stainless steel meshes with approximately 70% open area are being used for these experiments. If successful, the use of a wire-mesh support could increase the beta energy utilization efficiency by a considerable factor. Thus, perhaps as little as half as much of the radioactive component might be required in the preparation of a source for a given job. (auth)

15923 (TID-12392) ISOTOPIC METHOD FOR AGE DETERMINATIONS OF INDUSTRIAL PRODUCTS. Quarterly Progress Report, October–December 1960. T. C. Gregson and W. R. Miller (Goodyear Tire and Rubber Co., Akron, Ohio). Contract AT(11-1)-719. 34p.

Gasoline was labeled with an exempt concentration of Cl^{36}-tagged dodecyl chloride and S^{35}-labeled elemental sulfur dissolved in a benzene carrier. Five separate 60-ml samples were withdrawn from the dated gasoline masterbatch and aged for up to 50 days. The procedure for computing the ratio in which isotopes are present in a double-labeled sample when starting directly with liquid scintillation data is outlined. The initial isotope ratio was determined for each specimen and age values were computed. Observed ages were plotted against actual decay time. During the holding period, age errors ran from −88% to 142%. An age error of 32 times the isotope ratio error was predicted. The equipment to be used for rubber dating applications was completed and is operating satisfactorily. (M.C.G.)

15924 (AEC-tr-4139) RADIOACTIVE METHODS OF CONTROL AND REGULATION OF INDUSTRIAL PROCESSES. Transactions of Scientific-Technical Conference. N. N. Shumilovskii, I. M. Taksar, G. D. Latyshev, V. I. Verkhovskii, V. I. Sinitsyn, and V. A. Yanushkovskii, eds. Translated from a publication of the Publishing House of the Academy of Sciences, Latvian S.S.R., Riga, 1959. 315p.

A compilation is presented of papers on the use of radiation and radiation detection instruments in control of industrial processes, quality control, testing procedures, and automation. Separate abstracts have been prepared for 26 of the papers. (T.R.H.)

15925 (AEC-tr-4139(p.1-23)) AUTOMATIC PRODUCTION CONTROL WITH THE USE OF NUCLEAR RADIATIONS. N. N. Shumilovskii and L. V. Mel'ttser.

The principal development trends in the radiation instrument field are pointed out, and the specific results achieved are summarized. The main trend is toward increasing the accuracy of instruments by increasing source strength and detector efficiency, by use of compensation methods, modulated radiation, and automatic calibration, and use of frequency-, phase-, or time-dependent systems. Descriptions are given of the best examples of the following types of devices: densimeters, weight meters, thickness gages, level gages, gamma flaw detectors, gas pressure control, fluid flowmeters, radioactive relays, and composition controls. (T.R.H.)

15926 (AEC-tr-4139(p.24-34)) FUNDAMENTALS OF THE ORGANIZATION OF LABORATORIES FOR WORK INVOLVING THE USE OF RADIOACTIVE ISOTOPES. N. I. Leshchinskii.

A classification scheme for radioisotope laboratories is offered, and the organization and planning of a laboratory in each class is discussed with examples. Category I labs, which use exposed sources, are classed according to activity levels: over 10 mc; from 1 to 10 mc beta and 0.1 mg-equivalent Ra to 10 mc; up to 1 mc beta and up to 0.1 mg-equivalent Ra; any alpha activity level. This category is further classified by grades involving the amounts of radioactive materials used annually. Laboratories using only closed sources are not classified. General requirements for labs using radioisotopes are briefly summarized. (T.R.H.)

15927 (AEC-tr-4139(p.152-72)) ON UTILIZATION OF PENETRATING RADIATIONS FOR THE AUTOMATION OF COAL CONCENTRATION PROCESSES. V. G. Segalin.

A detailed analysis is made of radiometric systems for separating rock from useful minerals. The system treated uses gamma absorption to determine whether rocks moving with coal in a chute are to be ejected or not. Curves are given showing the difference in gamma absorption of coal and rock as a function of their linear dimensions, and dependence of coefficient of absorption of radiation on wavelength. A number of conclusions are drawn regarding the design of such systems. (T.R.H.)

15928 THE SELECTION OF RADIOISOTOPES FOR GAMMAGRAPHIC MATERIALS TESTING. R. A. Jonkers. Atoomenergie, 3: No. 1, 2-7(Jan. 1961). (In Dutch)

Nondestructive materials testing using radioisotopes is at a stage in which the investigator has at his disposal a number of radiation sources with acceptable properties. For any given problem the radioisotope giving the best results must be selected. The factors which are involved in the selection of the radioisotopes are briefly reviewed. (tr-auth)

15929 GAMMA LEVEL INDICATORS IN THE CHEMICAL INDUSTRY. [PART] I. H. Dijkstra and M. H. Lardinoye. Atoomenergie, 3: 17-24(Feb. 1961). (In Dutch)

Questions relating to the safety, calculation, construction, and apparatus in the utilization of gamma level meters in the chemical industry are discussed. In the first part of the article safety and calculation of the gamma devices are considered. (J.S.R.)

15930 EXPERIENCE WITH THE USE OF MICRODOSES OF GAMMA IRRADIATION IN POULTRY BREEDING. I. G. Kostin (Tomilin Poultry Factory). Biophysics (U.S.S.R.) (English Translation), 5: No. 4, 572-4(1960).

More than 75 000 hen eggs were exposed to chronic γ irradiation throughout the incubation period with a total dose of 2.9 r. The hatching of chicks rose an average 2.7% and the egg-laying capability of the hens grown from the irradiated embryos increased by 7 to 10%. Salts of U and Th in glass tubes were mounted in wooden frames which were placed beneath the tray holding the eggs for incubation. Experiments indicated that a dose rate of 100 μr/min gave best results. The procedure is described in detail and data are presented graphically. (C.H.)

15931 THE SELECTION OF SUITABLE ISOTOPES AND SATISFACTORY SOURCE STRENGTH FOR A GIVEN MASS DIFFERENCE PROBLEM. P. Platzek and J. Krugers (Central Laboratorium T.N.O., Delft, Netherlands). Kerntechnik, 3: 71-3(Feb. 1961). (In German)

In gaging problems by means of penetrating radiation, the purpose is the determination of variations in mass and not the absolute measurement of the mass. In this mass difference determination the magnitudes used in the measurement are the mean object thickness, the mean object density, mean mass/cm^2, and lowest measurable mass variation. It is shown that the mean mass alone determines the selection of the optimum radiation. The lowest measurable mass variation and the desired accuracy, together with geometric and apparatus factors in the radiation used, determine the necessary source strength. The methods used in selection of isotope and source strength are illustrated. (J.S.R.)

15932 RADIOACTIVITY IN THE REGION OF FATTY SUBSTANCES AND DERIVATIVES. I. GENERAL IDEAS ON RADIOACTIVITY. USE OF IONIZING RADIATIONS. A. Gatineau and A. Uzzan (Iterg, Paris). Rev. franc. corps gras., 6: No. 3, 165-77(Mar. 1959). (In French)

A general review is given of the properties and measurement of radioactivity. The preparation and properties of tracers are then briefly discussed, and techniques for the utilization of radioisotopes are reviewed. The effect of ionizing radiation on oils and lubricants, fatty acids, and foods is discussed. (J.S.R.)

15933 RADIOACTIVITY IN THE REGION OF FATTY SUBSTANCES AND DERIVATIVES. II. RADIOACTIVE ISOTOPES. A. Gatineau and A. Uzzan (Iterg, Paris). Rev. franc. corps gras., 6: No. 3, 228-39(Apr. 1959). (In French)

The use of tracers is reviewed by a discussion of the synthesis, analysis and determination, reactions, and biology of fatty materials. The use of radioisotopes in the industrial utilization of fatty materials is also reviewed. 80 references. (J.S.R.)

15934 IMPROVEMENTS IN SELF LUMINOUS LAMPS. (to U. S. Radium Corp.). British Patent 861,256. Feb. 15, 1961.

A self-luminous lamp structure is designed which uses T or Kr^{85} gas in conjunction with a phosphor. The lamp structure comprises a hollow gastight envelope of translucent nondarkening material, e.g., cerium-bearing glass, with an inside phosphor coating and 50 or 150 to 400 mm Hg T or K^{85} to excite the phosphor to luminescence. The structure may be in the form of a reflector to focus the luminescence. (D.L.C.)

ISOTOPE SEPARATION

15935 PROCESS AND DEVICE FOR THE SEPARATION OF LITHIUM ISOTOPES BY ELECTROLYSIS OF MOLTEN SALTS. E. Saito (to Commissariat a l'Energie Atomique). Belgian Patent 573,176. Priority date, Dec. 5, 1957. (In French)

$LiNO_3$ is chosen on account of its low melting point (255°C), in preference to LiCl. Cation migration at the cathode is slowed down by ionic counterflow produced by thermal decomposition of NH_4NO_3 fed on to the cathode. Li^6 finally concentrates near the cathode and Li^7 near the anode. (EURATOM)

15936 PROCESS AND DEVICE FOR THE SEPARATION OF ALKALINE METAL, PARTICULARLY LITHIUM ISOTOPES. A. Kepes (to Societe Saint-Gobain). Belgian Patent 573,868. Priority date, Dec. 20, 1957. (In French)

The compound used is molten lithium nitrate submitted to electrolysis. The electrode compartments are connected by a channel at a small angle to the horizontal. This channel is lined with lithium nitrate and its slope controls a countercurrent which slows down cation migration to the cathode. The nitrate is regenerated at the cathode by hot nitric acid vapor. The cathode is made of special anti-corrosion steel and the anode of Pt. (EURATOM)

15937 CENTRIFUGAL ISOTOPE SEPARATOR. (to SNECMA). Belgian Patent 597,350. Dec. 1, 1959. (In French)

The invention consists in adding to a gaseous isotopic mixture a sufficient volume of an auxiliary light gas to ensure a large dilution. The theory of aerodynamics can then be applied to the motion of these particles (molecules of isotopes) in a homogeneous medium (light gas). The apparatus described has no moving parts, is approximately cylindrical, and contains deflecting surfaces whose angle is chosen, taking into account the respective specific weights of the isotopes to be separated; because of this spinning flow only the heavier isotopes are extracted, the lighter ones remaining mixed with the diluting gas. (EURATOM)

15938 CONCENTRATION OF URANIUM ISOTOPES BY MOLECULAR DISTILLATION OF URANIUM POLY ALKOXIDES. (to United Kingdom Atomic Energy Authority). British Patent 863,259. Mar. 22, 1961.

A process is given for separating uranium isotopes, e.g., U^{235} and U^{238}, by molecular fractional distillation. In this process, uranium pentaethoxide or penta-n-propoxide is distilled under a vacuum of 10^{-3} to 10^{-7} mm Hg at a temperature between 100 and 210°C. An apparatus for this process is described. (D.L.C.)

15939 IMPROVEMENTS IN THE CONCENTRATION OF GASEOUS ISOTOPES. (to Ciba, Ltd.). British Patent 863,323. Mar. 22, 1961.

A process is given for the concentration of isotope of nitrogen and/or oxygen. In this process, nitric oxide containing the desired isotopes is concentrated by rectification. The nitric oxide fraction resulting from the rectification that has the lower isotope content is caused to undergo an exchange reaction with nitric acid or a nitrate or nitrite in acid solution at a temperature higher than that of the rectification, whereby the original starting isotope content is approximately re-established. (D.L.C.)

15940 PROCESS FOR THE PRODUCTION OF WATER OR HYDROGEN ENRICHED WITH DEUTERIUM. (to Friedrich Uhde G.m.b.H.). British Patent 864,026. Mar. 29, 1961.

A continuous process is outlined for the production of hydrogen impoverished in deuterium and water and/or hydrogen enriched in deuterium. In this process, the isotope exchange step is carried out by passing liquid water containing a finely divided catalyst with hydrogen to an isotope exchanger at a temperature below 100°C and at a pressure >30 atm. The catalyst is then removed from the enriched water, and some of the water is returned to the hydrogen producer for the production of enriched hydrogen, which is then supplied to the isotope exchanger. The hydrogen may be produced from carbon-containing compounds and water or by electrolysis by water. (D.L.C.)

15941 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF DEUTERIUM-ENRICHED COMPOUNDS. Peter Thomas Walker (to United Kingdom Atomic Energy Authority). British Patent 864,768. Apr. 6, 1961.

A process for producing deuterium-enriched NH_3 or H_2 is given wherein the NH_3-natural H_2O isotopic exchange reaction is replaced by a H_2-steam isotopic exchange reaction. In this process, circulating H_2 is contacted with liquid NH_3 containing KNH_2 catalyst in each tower of a two-tower dual-temperature apparatus. Deuterium-enriched NH_3 or H_2 is extracted from one of the deuterium-enriched streams between the hot and cold towers and subjected to distillation to increase the enrichment. Depleted H_2 leaving the cold tower is regenerated by contacting with steam of natural deuterium content in the presence of a catalyst for the H_2-steam reaction. The advantages of using the H_2-steam reaction in place of the NH_3-H_2O reaction for regeneration are simpler separation of water vapor from the regenerated H_2, possible reductions in stream sizes, and economy. (D.L.C.)

MATHEMATICS AND COMPUTERS

5942 (AEEW-M-104) A RELOCATABLE VERSION F THE MANCHESTER MERCURY AUTOCODE MASTER OMPILER. D. C. Bindon (United Kingdom Atomic Energy uthority. Research Group. Atomic Energy Establishent, Winfrith, Dorset, England). Dec. 1960. 9p.

A method is described by which a relocatable version of lercury Autocode was prepared. A special input scheme PIG 3) was developed which would accept the information in he Autocode Compiler in symbolic form and allow the inertion therein of preset modifiers. The method could be pplied to relocate other large Mercury programs in drum torage. (auth)

5943 (ANL-6319) ENGINEERING APPLICATIONS OF NALOG COMPUTERS. Lawrence T. Bryant, Marion J. anicke, Louis C. Just, and Alan L. Winiecki (Argonne Naonal Lab., Ill.). Feb. 1961. Contract W-31-109-eng-38. 8p.

Six examples are given of the application of analog comuters in the fields of reactor engineering, heat transfer, nd dynamics: deceleration of a reactor control rod by ashpot, pressure variations through a packed bed, reactor inetics over many decades with thermal feedback (simuation of a TREAT transient), vibrating system with two legrees of freedom, temperature distribution in a radiating in, and temperature distribution in an infinite slab with ariable thermal properties. (D.L.C.)

5944 (JINR-D-642) ON THE PROBLEM OF THE ETERMINATION OF PERMISSIBLE PHASE SHIFT REIONS IN THE PHASE SHIFT ANALYSIS BY THE 'RAVINE' METHOD. A. A. Tyapkin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1961. 6p.

A discussion is given of the phase shift analysis in which he minimum χ^2 is obtained in multi-dimensional space with a computer by gradient descending from the initial point chosen at random. The values of the phase shifts, corresponding to the minimum χ^2 determine the theoretical curves which best satisfy the experimental values of the quantities, $Y_1, Y_2, \ldots, Y_n$, which depend on the phase shifts. (B.O.G.)

15945 (NYO-9351) THE SINGULARITIES OF THE RIEMANN FUNCTION. Donald Ludwig (New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center). Jan. 1, 1961. Contract AT(30-1)-1480. 86p.

The Riemann function for linear hyperbolic systems of first-order equations is discussed. The leading term in the singularity of the Riemann function is determined and interpreted. In addition to equations with distinct characteristics, certain equations with multiple characteristics are treated. (auth)

15946 (ORNL-3082) MATHEMATICS PANEL ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1960. (Oak Ridge National Lab., Tenn.). Apr. 6, 1961. Contract W-7405-eng-26. 56p.

The construction of a translator to Oracle language from ALGOL, the international algebraic language, is described. The use of functions other than polynomials, e.g., trigonometric functions, as a basis for numerical quadrature in solving differential equations is considered. Functions satisfying a recursion in such a way that the stability of the computation is stabilized are evaluated, and matrices are studied with reference to localization of characteristic roots. Some problems in biology, medicine, health physics, and metallography requiring statistical analysis are described. Programming activities are described, including a program for analyzing the transmission data in neutron cross section determinations. A brief summary of the Oracle operating experience and practice is given. (D.L.C.)

15947 (SCTM-105-54(51)) A HUMAN ENGINEERING EXPERIMENT COMPARING A NOMOGRAPH AND A CALCULATOR. C. R. Clark, M. E. Hills, and J. G. Magistad (Sandia Corp., Albuquerque, N. Mex.). June 16, 1956. Contract AT(29-1)-789. 7p.

An experiment was designed and performed to compare the calculator and nomograph for speed and accuracy. Eight subjects made a series of calculations on the nomograph first and the calculator second while eight other subjects made the calculations with the calculator first and the nomograph second. Results indicate that the calculator is somewhat better than the nomograph, although no large differences were evident. (C.H.)

15948 (SCTM-181-56(51)) A MATHEMATICAL ANALYSIS OF A CALIBRATION SYSTEM. D. B. Owen and G. P. Steck (Sandia Corp., Albuquerque, N. Mex.). Sept 12, 1956. 26p.

Graphs are presented from which it is possible to determine the effects of a calibration system on the probabilities of accepting nonconforming components and of rejecting conforming components in the field. Graphs are also presented for determining loop closure tolerances to provide a probability of closure of 0.99 or 0.999. (auth)

15949 (TID-11866) TECHNICAL PROGRESS REPORT. PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. CIRCUIT RESEARCH PROGRAM. PART III. MATHEMATICAL METHODS. PART IV. ILLIAC USE AND OPERATION. PART V. IBM 650 USE AND OPERATION. PART VI. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). Aug. 1960. 33p.

The mechanical layout of flow-gating was finalized. The low-power circuit chosen as the final model of the flow-flop read-in driver was tested together with a quarter-word register and a read-out driver. An investigation of transformer-coupled tunnel diode circuits was completed. The basic circuit used for negative resistance modulation is described. The gravitational stress-energy tensor in an approximate theory of gravitation was studied. Five routines added to the Illiac Library and specifications for 17 new problems are discussed. Specifications are given for 16 new problems for the IBM 650. (M.C.G.)

15950 (TID-11867) TECHNICAL PROGRESS REPORT. PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. CIRCUIT RESEARCH PROGRAM. PART III. DATA REDUCTION METHODS. PART IV. ILLIAC USE AND OPERATION. PART V. IBM 650 USE AND OPERATION. PART VI. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). Sept. 1960. 31p.

Progress on the physical aspects of machine construction is reported. A new adder was placed in operation on the shift-unit #2 and 2 new memory units were tested. Investigation was begun on a set of nonsaturating logical circuits. An examination was made of the send driver of the flow-gating. Automatic reduction of data from bubble chamber photographs is discussed. The 3 routines and 10 specifications for new problems for the Illiac are described. Specifications for 12 new problems for the IBM-650 are also discussed. (M.C.G.)

15951 (TID-12496) THE PRACTICAL APPLICATION OF STATISTICS TO THE QUALITY CONTROL OF ELECTROPLATED PRODUCTS. James K. Gore and James J. Glass (Los Alamos Scientific Lab., N. Mex.). [1960?]. 33p.

Application of statistics to the practical inspection of a plated finish is discussed. By this method the accuracy of the plating process in any given lot of parts can be estimated. The use of variables criteria in acceptance handling is outlined. The application of the plan to receiving inspection of gold- and silver-plated parts is reviewed. The type of protection provided by variables sampling is illustrated. Compared to other inspection plans, the sample size is low. (M.C.G.)

15952 (WAPD-TM-243) KOAD-1—A DIGITAL PROGRAM TO CALCULATE STRESSES AND DEFLECTIONS IN LINEAR ELASTIC STRUCTURES UNDER THERMAL DISTORTION, PRESSURE AND APPLIED LOADS. C. M. Friedrich (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Mar. 1961. Contract AT-11-1-GEN-14. 67p.

KOAD-1 is a FORTRAN-II program developed to calculate thermal and pressure stresses in linear elastic structures, including three-dimensional piping networks and trusses. Matrix transformation theory was used to connect the elastic elements, to solve for redundant reactions, and to obtain deflections and stresses. (auth)

15953 MEASUREMENT OF NOISE POWER SPECTRA BY FOURIER ANALYSIS. A. Ziya Akcasu (Argonne National Lab., Ill.). J. Appl. Phys., 32: 565-8(Apr. 1961).

The theory of the direct Fourier analysis of noise power spectra with finite sampled data is developed. Formulas for planning a measurement for a specified resolution and accuracy are obtained. A quantitative comparison with autocorrelation analysis is given. It is shown that direct Fourier analysis attains comparable resolution and accuracy with the same amount of data. The computer requirements are also comparable in both cases. (auth)

15954 CRITERIA FOR THE RECURRENCE OR TRANSIENCE OF STOCHASTIC PROCESS. [PART] I. John Lamperti (Stanford Univ., Calif.). J. Math. Anal. and Appls., 1: 314-30(Dec. 1960).

Conditions for recurrence or transience of Markov chains are studied. Criteria of intermediate generality are established for some classes of processes with known transition probabilities which arise in queueing, random walks, etc. These criteria are established by use of a modified form of the semi-martingale theorem. (T.F.H.)

15955 ON MIXED BOUNDARY-VALUE PROBLEMS FOR AXIALLY-SYMMETRIC POTENTIALS. A. E. Heins (Univ. of Michigan, Ann Arbor) and R. C. MacCamy. J. Math. Anal. and Appls., 1: 331-3(Dec. 1960).

An axially symmetrical harmonic function U(r,y) is determined that corresponds physically to the potential of a disk in an external field. It is shown that U(r,y) may be found by reduction of the problem to a boundary-value problem for a harmonic function of 2 variables. U(r,y) may be found by this method for symmetric and non-symmetric external fields. (T.F.H.)

15956 AN UPPER BOUND FOR THE NUMBER OF PERIODIC SOLUTIONS OF A PERTURBED SYSTEM. Jane Cronin (Polytechnic Inst., Brooklyn). J. Math. Anal. and Appls., 1: 334-41(Dec. 1960).

An upper bound is set for the number of branching periodic solutions of a degenerate $\underline{n}$-dimensional system. This upper bound is determined by comparing an appropriate mapping in real Euclidean $\underline{n}$-space with its corresponding mapping in complex Euclidean $\underline{n}$-space. (T.F.H.)

15957 THE DIFFERENCE-DIFFERENTIAL EQUATION OF ELECTRON ENERGY DISTRIBUTION IN A GAS. B. Sherman (Westinghouse Research Labs., Pittsburgh). J. Math. Anal. and Appls., 1: 342-54(Dec. 1960).

The energy distribution of electrons in a gas is found by solving a difference-differential equation that arises in statistical physics. The existence and uniqueness of a solution are proved, and upper and lower bounds for a solution are set. Numerical calculation methods for finding the solution are developed. (T.F.H.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

15958 (AD-244256) RESEARCH AND DEVELOPMENT OF HIGH STRENGTH HEAT RESISTANT ALLOYS. Interim Report No. 11, February 27 through April 26, 1960. L. S. Richardson (Westinghouse Electric Corp. Research Labs., Pittsburgh). July 15, 1960. Contract NOas-58852-C. 17p.

The results obtained in the small button testing of Ta–W–Hf–Re alloys are presented and discussed. (auth)

15959 (AD-244257) RESEARCH AND DEVELOPMENT OF HIGH STRENGTH HEAT RESISTANT ALLOYS. Interim Report No. 10, December 27, 1959 through February 26, 1960. L. L. France (Westinghouse Electric Corp. Research Labs., Pittsburgh). Apr. 10, 1960. Contract NOas 58852-C. 19p.

The 3½-in. diameter ingot of 84% Ta, 8% W and 8% Hf is described. Additional button melts were prepared and additional data on previously reported compositions are presented. Apparatus for determining hardness at sub-atmospheric temperatures (20 to −196°C) is described. (auth)

15960 (AD-245900) THERMOELECTRIC MATERIALS. Bi-Monthly Progress Report No. 3, May 1, 1960–June 30, 1960. Merton H. Brooks (Titanium Alloy Mfg. Div., National Lead Co., Niagara Falls, N. Y.). July 15, 1960. Contract NObs-73326. 3p.

Varying amounts of ZrH_2, TiH_2, and oxides were added to TiO_2 and ZrO_2. Crystal phases present in the different compositions are being determined. Foreign oxides were also added to Li_2TiO_3 for testing. The following mixes were prepared and calcined: $Li_2CO_3 \cdot ZrO_2$, $Li_2CO_3 \cdot CeO_2$, $Li_2CO_3 \cdot SnO_2$, $Li_2CO_3 \cdot PbO_2$, $Na_2CO_3 \cdot CeO_2$, and $Li_2CO_3 \cdot Al_2O_3$. The La_2O_3 Standard Series of additions to $BaTiO_3$ was prepared. The Thermal Conductivity Comparator was completed. A furnace and specimen holder suitable to the 4-probe method of measurement were designed. (M.C.G)

15961 (AGN-8007) RUBIDIUM EVALUATION PROGRAM. Quarterly Technical Report No. 3 for Period February 1 through April 30, 1960. Peter F. Young (Aerojet-General Nucleonics, San Ramon, Calif.). April 30, 1960. 26p. Contract AT(04-3)-251. Project No. 5.

The objectives of the program are to test materials for compatibility with liquid Rb and vapor under static and dynamic conditions at high temperatures and to determine experimentally the thermodynamic properties of Rb. The static capsule test apparatus is being assembled. The first test will be performed at 1800°F for 100 hours in a 316 stainless steel capsule. The second test run will be at 1800°F for 500 hours in a Nb–Zr alloy capsule. The basic loop design was completed and design of instrumentation, controls, environmental chamber, and accessory equipment is being carried forward. The final design of the thermodynamic apparatus is being continued. (W.L.H.)

15962 (AGN-8016) RUBIDIUM EVALUATION PROGRAM. Quarterly Technical Report No. 6 for Period May 1 through July 31, 1960. Peter F. Young (Aerojet-General Nucleonics, San Ramon, Calif.). July 30, 1960. 31p. Contract AT(04-3)-251. Project No. 5.

The first corrosion test capsule run was completed. A type 316 stainless steel capsule containing ~12.5 g of Rb was subjected to a boiling-refluxing type static capsule test for 50 hours at 1550°F and 50 hours at 1800°F. Very little attack on stainless steel was observed. The final design of the basic corrosion loop was completed. A boiling apparatus will be used for measuring the vapor pressure-temperature equilibria and the latent heat of vaporization for Rb over the temperature range 1000 to 1800°F. (W.L.H.)

15963 (ARF-2210-1) IMPROVED VANADIUM-BASE ALLOYS. Bimonthly Report No. 1. (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Feb. 22, 1961. Contract NOw 61-0417-c. 13p.

Progress in the investigation to develop vanadium-base sheet alloys with improved elevated temperature strength is reported. Fabrication of the arc-cast "pancake" ingots to 0.050 in. sheet was performed by hot and cold rolling techniques. The V–30Nb alloy prepared using high-purity research-grade vanadium was cold rolled directly to sheet, whereas previously prepared material using commercial-grade vanadium could not be fabricated. Tensile testing of V–5Ti–20Nb-base compositions was conducted at room temperature, 1800°, and 2000°F. Specimens were protected by an inert atmosphere at elevated temperatures to prevent oxidation. The V–5Ti–20Nb–0.1B alloy was tested at 1800°F in the as-worked condition, but results did not show improvement over the fully annealed V–5Ti–20Nb alloy. (auth)

15964 (BM-RI-5758) ELECTROREFINING ZIRCONIUM. D. H. Baker, Jr., J. R. Nettle, and H. Knudsen (Bureau of Mines, Boulder City, Nev.). Apr. 1960. 12p.

Investigations were conducted to determine the feasibility of molten salt electrorefining of zirconium scrap, offgrade sponge, and alloys. Offgrade zirconium sponge having a Brinell hardness of 169 was refined by this technique to produce a metal having a Brinell hardness of less than 90. Zirconium alloy scrap, approximating Zircaloy-2 in composition was refined to recover zirconium metal with a Brinell hardness of less than 100 that was essentially free of the major alloying elements. The electrolyte that was successfully used consisted of molten sodium chloride to which sufficient potassium fluozirconate was added to produce a 2% zirconium content. Zirconium-chloride-bearing electrolytes were unsatisfactory and studies were suspended. Conditions established for the electrorefining of zirconium and the zirconium alloy studied were: 830 ± 10°C operating temperature, 0.2 to 0.5 v for cell voltage, and initial cathode current densities of 200 to 250 amps/ft^2. (auth)

15965 (CF-53-4-185) LITHIUM METAL PRODUCTION. P. S. Baker, F. R. Duncan, and H. B. Greene (Oak Ridge National Lab., Tenn.). May 1, 1953. Decl. Dec. 18, 1959. Contract W-7405-eng-26. 12p.

Investigations of methods for preparing small quantities of isotopic lithium metal were carried out. In addition to the development of an electrolytic procedure, a thermochemical reduction process involving LiCl and metallic barium was perfected. The metal may be prepared in quantities of from 10 to as much as 500 g at a time, with

yields of 60 to 70% and with a chemical purity of about 90%. Further purification by treatment of this metal with additional LiCl increased the purity to as much as 99%, depending upon the amount of salt used for the "cleanup." Methods for both batchwise and continuous countercurrent production of high-purity metal by thermal reduction were also developed. (auth)

15966 (DMIC-Memo-97) REVIEW OF RECENT DEVELOPMENTS IN THE TECHNOLOGY OF COLUMBIUM AND TANTALUM. E. S. Bartlett and F. F. Schmidt (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Apr. 10, 1961. 7p. (PB-161247)

A review is presented of major developments in the technology of niobium and tantalum, and their alloys, during the period from January through March, 1961. Mechanical properties of Ta–W, Ta–Nb–V, and Ta–Hf–W are tabulated. (B.O.G.)

15967 (LA-2510) PROPERTIES OF SOME PROPELLANT FLUIDS CONTAINING HYDROGEN. Don L. Bunker (Los Alamos Scientific Lab., N. Mex.). Dec. 31, 1960. Contract W-7405-ENG-36. 51p.

An approximate method of comparing specific impulses and thrusts of rocket propellants is described, taking account of the effects of chemical reactions in the nozzle and geometric restrictions on nozzle design. The results are presented of its application to the case of nuclear propellants composed of hydrogen to which have been added small quantities of various other substances. No additive substance which effects an increase in performance compared with that of pure hydrogen, by increasing the importance of the hydrogen dissociation-recombination reaction or by any other mechanism, is found. The reasons for this are discussed. Some combustion and frozen-free-radical systems accessible to this treatment are considered. (auth)

15968 (NDA-2118-1) DISSOLUTION AND SOLUBILITY OF METALS IN LITHIUM. Progress Report. B. Minushkin and H. Steinmetz (Nuclear Development Associates, Inc., White Plains, N. Y.). Mar. 31, 1960. Contract Nonr-2857 (00). 19p. (AD-245984)

The theoretical background and considerations leading to the choice of experimental methods for an investigation of the kinetics of dissolution and the solubility of structural metals in lithium are presented. The selection of methods, development of experimental techniques, and design, construction, installation, and testing of equipment are discussed. The apparatus consists of a stainless steel vessel with an inner liner of the metal under investigation for containing the lithium and a concentric cylindrical stirrer made of the same material as the liner. A method for following the dissolution process of iron using Fe^{59} tracer is described. Some preliminary tests on the solution rate were performed both with and without stirring at 1400°F. The data exhibited the expected trend, increasing concentration with and without stirring. (M.C.G.)

15969 (NMI-2094) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report to the United States Atomic Energy Commission for February 1961. (Nuclear Metals, Inc., Concord, Mass.). Apr. 14, 1961. Contract AT(30-1)-1565. 33p.

Progress is reported on the following: hot extrusion of uranium oxide; development of honeycomb fuel elements; yttrium fabrication; U^{233} recycle plant; β-phase uranium; hydrostatic fabrication; corrosion of zirconium alloys; and beryllium metallurgy. (B.O.G.)

15970 (NP-10021) THE SYNTHESIS AND EVALUATION OF NEW BASE STOCK FLUIDS FOR GAS TURBINE APPLICATION. Quarterly Progress Report No. 5 coverin Period December 1, 1960 to February 28, 1961. (Wyandotte Chemicals Corp., Wyandotte, Mich.). Mar. 1, 1961. Contract AF33(616)-6749. 81p.

Progress is reported on the synthesis and evaluation of new pyrazine derivatives for lubricant applications. New candidate products were obtained in good yield via the alkylation of the methyl site of 2-phenoxy- and 2-anilino-3-methylpyrazine classes of compounds. Mono- or dialkylation products could be obtained preferentially from these reactions by varying the ratio of reactants. Additional representatives of the 2-phenoxy-6-alkylpyrazine group of candidate products were also prepared by the selenium dioxide demethylation of the corresponding 2-phenoxy-3-methyl-6-alkylpyrazines intermediates. The preparation of some 2-(silylphenoxy)-3-methylpyrazine intermediates was initiated. The 2-phenoxy-3-alkylpyrazines, as a class, exhibited excellent thermal stability at 500°F. However, a structural rearrangement appeared to take place to some extent with some of these materials under the 600°F test conditions. The 2-anilino-3-alkylpyrazines tested so far displayed excellent thermal stability at 600°F. At least two representatives in this class, 2-(N-butylanilino)-3-pentylpyrazine and 2-(N-methylanilino)-3-(5-nonyl)pyrazine, showed oxidative stability at 500°F comparable to or better than Mil-L-9236 Formulation fluid. In addition, the 2-anilino-3-alkylpyrazines possessed lower viscosities than the 2-phenoxy-3-alkylpyrazines. Model compound studies were continued and a new process was developed for the alkylation, aralkylation, and acylation of methylpyrazines in tertiary amine solvents. This new process is believed to represent a promising method for performing reactions on the methyl site of methylpyrazine with reagents which are not compatible with liquid ammonia. (auth)

15971 (NP-10072) DEVELOPMENT OF EXO-REACTANT INORGANIC ADHESIVE SYSTEM. Summary Technical Report, July 1, 1958 through January 31, 1961. William Bassett, Robert Caughey, and Roger A. Long (Narmco Industries Inc., San Diego, Calif.). Contract NOas 60-6061-c. 110p.

A program to determine the feasibility of bonding stainless steel with exothermically reactive ceramic-metal adhesives, and to develop such adhesives if they proved feasible is described. It was found that comparable lap shear strengths could be produced in specimens bonded with a commercial braze alloy by means of furnace heating and by means of exothermic brazing. Lap shear strengths up to 1000 psi were obtained with the exo-reactant adhesives. However, impact shock brittleness and poor resistance to moisture severely limited further development of these systems. Combination metal-oxide and metal-glass exothermic systems were developed. These exothermic silver-base and copper-base adhesives gave metallic bonds which, on the basis of stainless steel tensile lap shear strengths, showed strengths in excess of 9000 psi at all temperatures up to 800°F. Reactive and inert constituents were combined to produce a fluid glass, which could be squeezed out of the bond area, and a stainless steel wetting alloy that remained in the bond area as a braze filler metal. The silver-base exo-reactant adhesive systems were adapted to stainless steel honeycomb panel bonding. Exothermically bonded stainless steel panels gave flexure and edgewise compression strengths of 84,300 and 61,900 psi compared to 160,000 and 115,000 psi provided by the conventionally furnace brazed panels. (auth)

15972 (PRL-5.31) FLUIDS, LUBRICANTS, FUELS AND RELATED MATERIALS. Quarterly Report, July, August, and September 1960. (Pennsylvania State Coll.,

ate College. Petroleum Refining Lab.). Sept. 30, 1960. ntract AF33(616)-5460. 94p.

The design, construction, and calibration of a complete pillary type pressure viscometer is described. Design d construction of auxiliary equipment for dissolving gas fluids under pressure and for measuring the amount of luble gas in these fluids are also discussed. The calibra- on of the viscometer with mineral oils and the effect of ssolved gases in the liquid film clinging to the viscometer all is discussed in detail. Techniques for saturating vis- ous fluids with nitrogen are described. The effect of dis- olved gas on viscosity at various pressures was deter- ined. Viscosity-pressure characteristics of several ineral oils and esters were measured and compared with iscosity-temperature characteristics and the effect of gas aturation on viscosity. Comparisons between these pre- ision pressure viscosities and literature values are made. number of fluids taken from storage after 2 to 17 years ere evaluated for property changes. The effect of extended torage on the oxidation and corrosion stability of the fin- shed fluids and the individual components was examined. he evaluation of these early samples is based on the es- ablishment of equivalent test severity in the present test echniques. The effect of additional oxidation inhibitor on tored fluids and the properties of fluids compounded from components stored separately is presented to confirm the storage stability of mineral oil-base hydraulic fluids. A sample of hydraulic fluid from the "Lady Be Good" B-24 omber which crashed 17 years ago on the North African desert was thoroughly studied for storage stability prob- lems. The effect of polar constituents formed in high tem- perature oxidation and thermal tests on lubricity behavior is demonstrated at 167°F. using the standard 52-100 steel bearings. The same fluid types and additives used in pre- vious high temperature lubricity tests are included in this series of tests. The similarity of chemical effects between lubricity tests at high temperatures and lubricity tests with products produced by high temperature reaction is demon- strated. A quantitative oxidation test in which air is used as the oxidizing medium is described and compared with the classical Dornte type quantitative oxidation test. The effects of temperature and superrefining treatments of mineral oils are used to illustrate this technique. In all cases the mate- rial balance and analytical techniques show specifically the amount of unoxidized hydrocarbon as well as the types and amounts of liquid and gaseous reaction products containing oxygen. (auth)

15973 (SB-453) HIGH TEMPERATURE RESEARCH (CERAMICS, GASES, LUBRICANTS, PLASTICS, ELECTRICAL AND ELECTRONIC EQUIPMENT, ETC.). OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Feb. 1961. 36p.

This selective bibliography covers reports received during the period 1950 to 1961 on various aspects of high-temperature research. (C.H.)

15974 (TID-6930) LITERATURE SURVEY OF USES OF URANIUM OXIDES IN THE CERAMIC INDUSTRY. C. C. Fain, C. M. McClure III, and G. C. Robinson (Clemson Agricultural Coll., S. C.). Aug. 1960. 55p. Subcontract 1484.

The survey includes the uses of uranium oxides in refractories, glazes and glasses, additives to refractories and abrasives, nuclear fuel elements, artificial teeth, diffusion reaction tracers, and in the laboratory. (W.L.H.)

15975 (TID-11394) PRODUCTION OF A SINTERABLE HIGH-PURITY BERYLLIUM OXIDE. Final Report. Technical Report No. 149. Byron Lympany and John G. Theodore (Brush Beryllium Co., Cleveland). Mar. 1959. For General Electric Co. Aircraft Nuclear Propulsion Dept. 55p.

Development is described of a method for producing BeO which can be sintered to 2.90 to 3.00 g/cc, is highly pure, and is uniform. Calcination of BeO decomposed from sulfate was best carried out at 850 to 950°C for maximum sinterability while the best calcination temperature for the oxide decomposed from the oxalate was 750 to 950°C. Considering all of the procedures, those for removal of Si, Na, and Li were the major unsolved problems. (J.R.D.)

15976 (TID-11817) PROGRESS REPORT [ON MATERIALS RESEARCH]. (Nebraska. Univ., Lincoln). Feb. 1, 1961. Contract AT(11-1)-525. 51p.

Corrections and improvements were made in the calorimetric measurement of stored energy in x-irradiated alkali halide crystals. Data obtained after the improvements were reproducible and seven runs were completed. Results indicated that for F-center densities between 2.5×10^{17} and $6.4 \times 10^{17}/cm^3$, the stored energy varied linearly with the concentration of F centers. Based on certain assumptions, it was concluded that there is a stored energy of about 5 ± 3 ev associated with the vacancy or pair itself. The energy dependence of radiation damage in metals was investigated. The effects of irradiating the metal at oblique incidence were also studied to determine if surface effects on the metal play a role in the results of measurements of radiation damage. It was found that the number of defects produced in the metal is a linear function of the proton beam energy. Preliminary data indicated that surface effects are not too important for the depths of penetration involved with 200 kev at the oblique angles of incidence studied. An investigation is being made of the non-linear characteristics of electrical conduction in ionic solids. In measurements made on NaCl, a heat current was detected at temperatures substantially lower than expected. The current was larger by about a factor of 100 than that predicted by theory. The electrical conductivity of sodium chloride crystals grown from distorted seeds was also measured. The ratio of the conductivity of the crystal grown from the bent seed to that of a crystal grown from non-bent seed was found to be greater than 1. It was discovered that the activation energy for conductivity depended on the impurity concentration. (M.C.G.)

15977 (TID-12364) FUNDAMENTAL STUDIES IN HIGH TEMPERATURE MATERIALS PHENOMENA. Progress Report for June 1, 1960–March 21, 1961 and A Proposal for Renewal of Contract. SCOPE I. HIGH TEMPERATURE-PRESSURE PHYSICAL PROPERTY MEASUREMENTS. M. E. Bell, W. R. Buessem, Rustum Roy, and C. Crowe. SCOPE II. ELECTRICAL RESISTIVITY MEASUREMENTS OF MATERIALS IN RELATION TO HIGH-TEMPERATURE TRANSFORMATIONS. G. W. Brindley (Pennsylvania State Univ., University Park. Coll. of Mineral Industries). Mar. 21, 1961. Contract AT(30-1)-2581. 11p.

Apparatus was designed and constructed for the establishment of a general physical measurements facility. Included were 4 instruments for dielectric and dissipation factor measurements and 11 for resistivity measurements. Conditions for preparing samples of compacted "pellets" of possible theoretical density by the "pressure sintering" process were studied. The problem of detecting the effects of chemically introduced defects of different types on the dielectric loss "spectrum" was investigated. Natural fluorites with different color centers are being studied to determine the nature of the defects. (M.C.G.)

15978 (UCRL-9586) THE INFRARED SPECTRA OF MARGINALLY METALLIC SYSTEMS, SODIUM–AMMONIA

SOLUTIONS. Tad A. Beckman and Kenneth S. Pitzer (California. Univ., Berkeley, Lawrence Radiation Lab.). Feb. 1961. Contract W-7405-eng-48. 24p.

The sodium—ammonia solution system permits investigation of an array of compositions spanning the transition from nonmetallic to metallic bonding. Reflection spectra in the range 1 to 20 μ were measured for solutions of mole ratio 5.5 to 168 NH_3 per Na. The dilute solutions show peaks characteristic of the vibrations of ammonia and a strong peak near 1.5 μ which is assigned to the solvated Na_2 species. Concentrated solutions show high reflectivity over broad wavelength ranges. The results for nearly saturated solutions are fitted reasonably by the free electron model, but in the range of mole ratio 10 to 15 a complex array of energy absorption processes of finite frequencies are required to fit the spectra. (auth)

15979 (WADD-TR-61-68(Pt.I)) BASIC FACTORS IN THE FORMATION AND STABILITY OF NON-SOAP GREASES FOR HIGH TEMPERATURE APPLICATIONS. John J. Chessick and Albert C. Zettlemoyer (Lehigh Univ., Bethlehem, Penna. Inst. of Research). Mar. 1961. Contract AF33(616)-7120. 33p.

Major interest centered on the preparation of thickener solids with improved properties for high temperature applications. Surface treatments of available, high area solids such as silicas and attapulgite clay by phenol-formaldehyde resins or by ion-incorporation techniques proved successful. The properties of greases prepared with other thickeners were investigated also. These thickeners included carbon blacks, fiber glass and a finely divided laboratory prepared MoS_2. Most show promise for use in non-soap grease systems. A literature survey of inorganic liquids was undertaken. (auth)

15980 (AEC-tr-4405) PREPARATION OF CALCIUM BY THE DISSOCIATION OF CALCIUM CARBIDE. (Poluchenie Kal'tsiya Dissotsiatsieĭ Karbida Kal'tsiya). A. S. Mikulinskiĭ and F. S. Maron. Translated from Zhur. Priklad. Khim. 33, 835-41(1960). 10p.

Various methods used to prepare Ca metal are reviewed, and the feasibility of CaC_2 decomposition at high temperatures as a method of preparation of Ca was investigated. Technical grade CaC_2 containing 16 to 23% CaO was heated in a heater-condenser assembly at 1600 to 1820°C and at a pressure of 0.5 to 1 mm Hg. It was found that, if temperature gradients are set up in the condenser, Ca metal of satisfactory purity can be obtained. From material containing 83% CaC_2 and 16% CaO, a condensate containing 94.8 to 98.2% Ca, 0.0085% Fe, 0.009% Si, and 0.012% Mg and a residue containing 94 to 98.5% C was obtained. The condensate distribution indicates that the reaction $CaO + C \rightarrow Ca + CO$ precedes the reaction $CaC_2 \rightarrow Ca(vapor) + 2\,C(graphite)$. (D.L.C.)

15981 (NP-tr-589) POWDER METALLURGY. S. A. Tsukerman. Translated from p. 89-96; 125-36; 154-7 of "Poroshkovaya Metallurgiya." (A publication of the Publishing House of the Academy of Science, Moscow, 1958). 27p.

Descriptions are given of hot-pressing equipment and techniques applicable to powder metallurgy. Development work done in producing antifrictional and heat-resisting alloys is discussed. The economic and development prospects of powder metallurgy are described. (B.O.G.)

15982 FERROUS METALLURGY. H. F. Beeghly and L. C. Pasztor (Jones & Laughlin Steel Corp., Pittsburgh). Anal. Chem., 33: 70R-6R(Apr. 1961).

A bibliography review is given on analytical methods for ferrous metals for the period November 1958 to September 1960. Most of the methods are refinements of existing procedures. (N.W.R.)

15983 NONFERROUS METALLURGY. C. J. Leftault, Jr and M. L. Moss (Aluminum Co. of America, New Kensington, Penna.). Anal. Chem., 33: 76R-87R(Apr. 1961).

A bibliography review is given on analytical methods for nonferrous metals for the period August 1958 to August 1960. Within the scope of the review are papers concerning the determination of all constituents present in nonferrous metals, alloys, oxides, and ores by chemical, spectroscopic, and radiochemical methods. (N.W.R.)

15984 COMPOSITE CERAMIC-METAL SYSTEMS. A. V. Levy (Aerojet-General Corp., Sacramento, Calif.), S. R. Locke and H. Leggett. Astronautics, 6: 27-29(Apr. 1961).

Composite ceramic-metal systems are under development for service at temperatures of 3000 to 6000°F for a variety of space-vehicle applications. A discussion of the new composite systems, mechanical reinforcement problems, and matrix material performance is presented. (N.W.R.)

15985 STUDY, BY MEANS OF RADIOINDICATORS, OF THE IMPURITY ENRICHMENT DURING THE OXIDATION OF STEELS. Ch. de Beaulieu, M. Cagnet, and J. Moreau (IRSID, Saint-Germain-en-Laye, France). Mém. sci. rev. mét., 57: 863-75(1960). (In French)

The extreme generality of the phenomenon of enrichment in the region near the metal-oxide interface during oxidation was confirmed for binary and ternary ferrous alloys where the alloying element is in very small quantities and can be considered as the principal impurity. This effect is found both for metallic elements (copper, chromium, cobalt, molybdenum, and tungsten) and for metalloid elements (sulfur, phosphorus, and arsenic); only manganese is the exception and is dissolved in the iron oxides. However, even if it is admitted that the oxidation of a steel causes the alloying elements and the impurities to be driven toward the metal-oxide interface, the chemical combination of these impurities can not be distinguished. The effect of sulfur on the oxidation in air or in hydrogen or water vapor atmospheres was studied on iron—sulfur alloys with low sulfur concentrations. It was shown that the enrichment at the metal-oxide interface, in the form of iron sulfide, depends on the quantity of oxided iron. These results seem to exclude the possibility of desulfuration of iron across a compact and continuous oxide layer. A mechanism can be outlined when the first linear stage of oxidation is interpreted by an interfacial reaction limited by the chemical absorption of oxygen on the oxide. (tr-auth)

15986 PARAMAGNETIC BEHAVIOR OF METALLIC CERIUM AND EUROPIUM. R. V. Colvin, Sigurds Arajs, and J. M. Peck (U. S. Steel Corp. Research Center, Monroeville, Penna.). Phys. Rev., 122: 14-18(Apr. 1, 1961).

The magnetic behavior of metallic polycrystalline cerium and europium was studied above room temperatures. The measured paramagnetic behavior of cerium can be explained using the interacting Ce^{+++} ion model ($\theta = -50°K$) and the Van Vleck theory of paramagnetism with an additional temperature-independent paramagnetic term $\chi_c = 1.00 \times 10^{-6}\ g^{-1}\ cm^3$ resulting from the conduction electrons. Europium metal has an unusual magnetic behavior. Its paramagnetic properties in the solid state cannot be explained on the basis of the noninteracting Eu^{++} model. Near the melting point metallic europium behaves as a collection of weakly interacting Eu^{+} ions. The Bohr magneton number of liquid europium is very close to that of Eu^{++} ions. (auth)

87 THE POWDER METALLURGY OF RUTHENIUM. G. Cope (Glacier Metal Co., Kilmarnock, Ayshire, Eng.) D. W. Rhys. Powder Met., No. 7, 139-55(1961). An investigation of the powder metallurgy of ruthenium described, from the reduction of ammonium ruthenium oride to the working of sintered compacts. The powder operties measured were specific surface area, by a plified BET method, and tap density. The dependence hese properties on the conditions of reduction was de- mined. The surface area of powders varies from 1 to m^2/g in the temperature-of-reduction range 700 to °C. The tap density is also variable (1 to 3 g/cc) and is erally related to the surface area. The effects of com- ting pressure and temperature on sintering are de- ibed, the progress of sintering being observed by meas- ements of the "open" and "closed" porosity present in mples. Compact densities up to 95% of theoretical can be ained by sintering at 1500°C. The selection of powder operties and compacting pressures to be used in the oduction, by vacuum sintering at 1500°C, of high-density mpacts for working, is governed by the necessity to main- n open porosity during the heating cycle up to at least 0°C, as considerable gas evolution occurs at this tem- rature; at the same time it is essential that good densi- ation shall have occurred even at this stage. These con- ions can be met by using powder with a surface area of o 5 m^2/g and compacting pressures in the range 0.5 to tons/in^2. Observations on the hot working of sintered mpacts indicate that ease of working is related to the rface area of the powder. (auth)

988 POSSIBLE AND IMPOSSIBLE IN RADIOGRAPHY. arlem, Netherlands, N. V. De Technische Uitgeveri j H. am. 96p. $18.75.

Radiographs were made of fusion butt welds in 20 mm ick steel plate containing defects intentionally inserted r the purpose of the investigation. By the addition of eel plates of known thickness the total thickness of the ate was increased in stages up to 120 mm. X-ray equip- ent of various types up to a maximum voltage of 31 Mev nd Ir^{192} and Co^{60} γ sources were used in making the radio- aphs, using various standard techniques and equipment. ata are summarized in Dutch, German, French, Spanish, nd English. (C.H.)

5989 PREPARATION OF SINTERED BERYLLIUM XIDE. (to Commissariat a l'Energie Atomique). Belgian atent 569,700. Priority date, Sept. 6, 1957. (In French)

The raw material is $Be(OH)_2$ with a high proportion of ne beta variety. A mineral acid (or a corresponding Be alt) is added in order to obtain only BeO. To prepare ompacts, powdered BeO is sintered in a graphite mold at 300 to 1500°C under a pressure of 2100 psi, after having een mixed with a neutron-absorbing substance such as B_4C. (EURATOM)

5990 PREPARATION OF NIOBIUM OXIDE. Sté echiney (to Cie de Produits Chimiques et Electrometal- urgiques). Belgian Patent 580,485. July 11, 1958. (In French)

Nb is separated from metals of the 3rd, 4th, 5th, and 8th roups, such as Fe, Ta, Mn, Ti, Si, Cu, Al, and Sn, by pass- ng a solution of metal chlorides or fluorides through an nion exchange resin, which retains only Nb and part of the Fe. Fe and Nb are separated by selective elution with NaCl, which also regenerates the ion exchanger, a quaternary ammonium salt. Niobium hydroxide is precipitated with ammonia, washed, dried, and calcined to high-purity Nb_2O_5. (EURATOM)

Corrosion

15991 (AERE-M-787) THE KINETICS OF THE UPTAKE OF CORROSION HYDROGEN BY ZIRCONIUM ALLOYS. N. J. M. Wilkins and J. N. Wanklyn (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1960. 6p.

The hydrogen content of zirconium alloy specimens with increasing weight gains are reported. When plotted to show the successive uptakes of hydrogen and oxygen, the results show that the percentage hydrogen uptake prevailing at any instant may increase as corrosion proceeds. The final value is in the range 80 to 100%. (auth)

15992 (ARF-2198-15) IMPROVED ZIRCONIUM ALLOYS. Quarterly Report for January 1, 1961—March 31, 1961. (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Apr. 11, 1961. Contract AT(11-1)-578, Project Agreement No. 1. 9p.

Corrosion testing data are presented for a large number of Zr alloys in 680°F water (1043 and 1902 hr), 750°F steam (329 hr), and 900°F steam (97 hr). These alloys include Zircaloy-2 and Zr alloyed with Nb, Sn, V, Sb, Cr, Cu, Fe, Si, W, Mo, Ta, Co, Pt, Pd, Rh, As, Bi, Te, Ge, Ag, and Ni. Tensile test data are also reported for ten of these alloys at 680°F; these alloys are Zr alloyed with Nb, Sn, Fe, V, Cr, Mo, Sb, and Co, in addition to unalloyed Zr and Zircaloy-2. (D.L.C.)

15993 (BMI-1507) CORROSION OF THORIUM AND URANIUM UNDER STORAGE CONDITIONS. Elmer F. Stephan, Paul D. Miller, and Frederick W. Fink (Battelle Memorial Inst., Columbus, Ohio). Mar. 21, 1961. Contract W-7405-eng-92. 24p.

Thorium, uranium, and uranium—10 wt.% molybdenum-alloy specimens in the form of bare and organic- or metal-coated single coupons and composite assemblies joined by soldering, welding, or the use of machine screws were evaluated for corrosion resistance in accelerated and long-term tests providing exposure to ambient, humidity, salt-spray, and humidity-freezing conditions. Environments involving high humidity or a salt fog caused a localized type of attack on all the materials. The uranium-10 wt.% molybdenum alloy was most durable. Thorium was fairly resistant. The uranium became badly pitted and roughened under almost all conditions studied. The vinyl-type organic coatings blistered during the exposures, particularly when applied to uranium. Aluminum coatings on uranium behaved similarly. Nickel coatings plated on thorium showed excellent resistance. No galvanic effects were observed in couples prepared from dissimilar metals, even at crevice areas and mating surfaces on specimens joined by machine screws. (auth)

15994 (NP-9912) FUNDAMENTAL CORROSION RESEARCH. Final Report for the period November 1, 1960—January 31, 1961. Report No. 20. M. G. Fontana and F. H. Beck (Ohio State Univ. Research Foundation, Columbus). Jan. 31, 1961. Contract Nonr-495(11). 33p.

A stress-corrosion study was made of the effects of a potassium chromate-sodium chloride solution on a 6 Al—^{93}Mg—1 Zn alloy. Corrosion currents in both intergranular and transgranular stress-corrosion are discussed. The effects of iron content, heat treatment, grain size, stress level, mechanical properties, time under load, pH, and surface treatment are discussed. Studies were made of the "wedging action" of corrosion products developed during stress-corrosion cracking tests of austenitic stainless

steel by 400°F water containing NaCl. The nature of the corrosion products was found to cause a "wedging action" in confined regions, which had a significant role in the initiation and propagation of the stress-corrosion cracks in the stainless steel. (B.O.G.)

15995 (SCNC-315) HIGH TEMPERATURE OXIDATION RESISTANT COATINGS FOR TANTALUM BASE ALLOYS. First Quarterly Progress Report, June 1, 1960 to August 31, 1960. (Sylvania-Corning Nuclear Corp., Bayside, N. Y.). Contract AF 33(616)-7462. 23p.

The effect of various dipping times, temperatures, and diffusion treatments was determined for tantalum sheet dipped in aluminum alloy baths. Both aluminide and beryllide coatings were produced that will withstand oxidation for 10 hours at 2500°F, isothermally and cyclic. Aluminide coatings were obtained on a stressed niobium alloy that meets the same test conditions. (auth)

15996 (SCNC-320) HIGH TEMPERATURE OXIDATION RESISTANT COATINGS FOR TANTALUM BASE ALLOYS. Second Quarterly Progress Report, September 1, 1960 to November 30, 1960. (Sylvania-Corning Nuclear Corp., Bayside, N. Y.). Contract AF 33(616)-7462. 46p.

Aluminide and beryllide coatings were applied to pure tantalum and Ta-10% W sheet and evaluated. Some work was done with niobium alloys and with tantalum compounds. Methods of application included hot dipping in aluminum and tin base baths, slurry painting of aluminum alloys, and vapor-solid reactions for beryllium. Both types of coatings appear promising for 10 hours at 2500° to 2600°F and for somewhat shorter times at 2700° to 2800°F. Tin base baths gave duplex coatings which appear self healing and resistant to damage in handling. Anomalous aluminide coating behavior was noted below 2500°F. Several methods of oxidation testing were used and compared. Stability of surface compounds was investigated metallographically. (For preceding period see SCNC-315.) (auth)

15997 (WADD-TR-60-436) THE COMPATIBILITY OF VARIOUS METALS AND CARBON WITH LIQUID FLUORINE. Charles J. Sterner and Alan H. Singleton (Air Products, Inc., Allentown, Penna.). Aug. 1960. Contract AF33(616)-6515. 110p. (AD-244309)

Experimental studies were made to determine the compatibility and resistance to corrosion of various metals and carbon with liquid fluorine at −320°F. The metals tested were various alloys of aluminum, stainless steel including high-strength steels, titanium, copper, Monel metal, nickel, and magnesium. Tests which were performed included: continuous immersion of stressed and unstressed samples in liquid fluorine for periods up to two weeks; impact ignition of titanium and aluminum in liquid fluorine and of titanium in liquid oxygen at impact energy levels ranging from 2.6 to 65 ft-lb; intensive and extensive impact on tubes containing liquid fluorine; passivation and storage for periods up to 64 days followed by immersion in liquid fluorine; thermal shock of samples, both by liquid fluorine and in contact with liquid fluorine; flexing of metal samples immersed in liquid fluorine; tearing of metal samples while immersed in liquid fluorine; the explosibility of contaminant in liquid fluorine. It was found that the corrosion of the metals tested in pure liquid fluorine was negligible, generally amounting to less than 1 mil penetration per year. However, contamination of liquid fluorine resulted in severe corrosion. Graphitic carbon was found to be incompatible although dense amorphous carbon was affected only slightly. Titanium was found to ignite upon impact in liquid fluorine although the ignition did not propagate. No evidence was found to support the theory that a fluoride film is required to protect metals from attack by liquid fluorine. Passivation by gaseous fluorine is recommended as an extension of the cleaning procedure despite the lack of real evidence that passivation is required for materials which have been thoroughly cleaned. (auth)

15998 (CEA-tr-A-819) CONTRIBUTION A L'OXYDATION INTERNE DES ALIAGES DE NICKEL. (Contribution to the Internal Oxidation of Nickel Alloys). W. M. Schwartzkopf. Translated into French from Z. Elektrochem., 63: 830-4(1959). 20p.

Internal oxidation in binary alloys of nickel with chromium or aluminum is possible only if the concentration is kept below 9 wt % chromium or 4 wt % for aluminum. With higher concentrations the increased diffusion velocity of the admixed metal creates surface oxidation. With a concentration of 2 wt % aluminum, the size of the oxide particles changes from 10 to 0.1 microns, as function of the oxidation temperature the temperature decreases from 1300 to 700°C. (tr-auth)

15999 (CEA-tr-X-246) RECHERCHES EXPERIMENTALES SUR LA CORROSION DU MAGNESIUM. XIII. PROCESSUS DE CORROSION ELECTROCHIMIQUE. (Experimental Studies of the Corrosion of Magnesium. XIII. Processes of Electrochemical Corrosion). G. Wada. Translated into French from Nippon Kagaku Zasshi, 79: 1461-7(1958). 33p.

It was previously shown that the corrosion of magnesium with release of hydrogen in an aqueous electrolyte follows two reaction forms: electrochemical processes which begin on the metal by local cells at the surface and non-electrochemical processes which are produced by the direct action of the water of hydrolysis on magnesium under the influence of an ionic catalyst. For an experimental confirmation, the following test was made. After connecting magnesium and platinum electrodes with a conducting wire, a current was applied to submit the magnesium to an anodic polarization. The hydrogen which is released at the platinum electrode gives the hydrolysis velocity v_{Pt} caused by electrochemical processes. The hydrogen produced at the magnesium electrode gives the hydrolysis velocity v_{Mg} from the non-electrochemical processes. A study was then made of the order of magnitude of the effect of a small quantity of an impurity added to the 0.5 N solution of KCl on the reaction speeds. The experimental results led to the following conclusions: The polarizable hydrolyzing radicals in the molecules of an impurity adsorbed on the metallic surface restrains, in a general manner, the electrochemical corrosion because it prevents direct contact between the water and the metal. The polarizing radicals have a very strong affinity for the ions unstabilizing the ionized water. This lowers the activation of the reaction so that the hydrolysis is accelerated. (J.S.R.)

16000 ELECTROCHEMICAL MEASUREMENTS OF CORROSION RATES ON ZIRCONIUM AND ZIRCALOY-2 AT ELEVATED TEMPERATURES. A. L. Bacarella (Oak Ridge National Lab., Tenn.). J. Electrochem. Soc., 108: 331-6(Apr. 1961).

Electrochemical measurements of corrosion rates are performed on crystal bar zirconium and Zircaloy-2 in highly oxygenated, dilute sulfuric acid at 167 and 208°C. The calculated rates of corrosion obtained from the small current polarizability measurements are roughly hyperbolic in rate-time. Some reproducible but unexplained observations concerning the potentials and polarizabilities of the Zircaloy-2 during the first several minutes of reaction are also discussed. (auth)

16001 ATMOSPHERIC CORROSION TESTS OF SEVERAL DELTA-PHASE ALLOYS OF PLUTONIUM. J. T. Waber, W. M. Olson, and R. B. Roof, Jr. (Los Alamos Sci-

ntific Lab., N. Mex.). J. Nuclear Materials, 3: 201-15 Feb. 1961).

A study of the oxidation of delta-phase, binary plutonium lloys containing small additions of aluminum, cerium, haf-ium, zinc, and zirconium was conducted. The oxidation ates at 75°C in moist air are all lower than the oxidation ate of unalloyed plutonium under the same conditions. The esults do not appear to be in accord with the simple theory f the influence of solute additions on the oxidation rate as roposed by Wagner and Hauffe. A size rule was suggested or deciding a priori whether a solid-solution miscibility ap between oxide phases might occur. Th s rule was only artially successful in predicting which oxide phases would e observed to form separate layers. It is interesting that he zirconium and hafnium alloys were found to form ZrO_2 nd HfO_2 as separate phases in the oxide layer. These eparate oxide phases are to be expected on the basis of the size-factor rule discussed above. There is no evidence, owever, that Al_2O_3 or ZnO, in which smaller metal-oxygen istances occur, were present as separate phases in the xidation products. For thermodynamic reasons, ZnO should not appear in the products. The special reasons that Ce_2O_3 and Al_2O_3 might not be detected were discussed. The analyses of Wagner concerned with the formation of single or duplex oxide films were discussed and it is shown that the formation of HfO_2 and ZrO_2 as well as Al_2O_3 and Ce_2O_3 should occur. The apparent reduction in rates can be rationally interpreted on this basis. (auth)

Fabrication

16002 (AD-209135) BERYLLIUM CASTING. PHASE I: (9/19/58-11/19/58). Paul M. Cohen (Beryllium Corp., Reading, Penna.). Contract AF33(600)-37902. 11p.

A survey was made of the literature pertaining to the casting and melting of beryllium. 22 references. (auth)

16003 (AD-244292) EVALUATION OF THE PRODUCIBILITY OF TWO NEW TITANIUM BASE SHEET ALLOYS, Ti-7Al-12Zr AND Ti-5Al-5Zr-5Sn. Bi-Monthly Report No. 3, July 1, 1960-August 31, 1960. T. Vretas (Republic Steel Corp. Titanium Research Lab., Canton, Ohio). Sept. 6, 1960. Contract NOas 60-6035-C. 11p.

Progress in Phase I activities are reported. Three hot-rolled sheets 0.50 × 24 × 60 in. were fabricated from a ½-in. sheet bar previously produced from Ti-7Al-12Zr alloy by roll-finishing at 1700, 1750, and 1800°F an optimum temperature was found at 1750°F. Chemical uniformity tests on the Ti-7Al-12Zr specimens are reported along with results of a microhardness test. (J.R.D.)

16004 (AMC-TR-60-7-588) HIGH ENERGY RATE METAL FORMING. Final Technical Engineering Report, October 18, 1957 to August 1, 1960. F. C. Pipher, Glen N. Rardin, and W. L. Richter (Lockheed Aircraft Corp., Burbank, Calif.). Oct. 1960. Contract AF33(600)35543. 416p.

High-energy-rate metal-forming techniques, for fabrication of structural high-strength components for airframe and spacecraft sheet metal application are presented. The forming techniques demonstrate that the controlled application of the energy available from high-velocity explosives is a safe, efficient, and economical production forming method. The inherent advantages, as well as the limitations of the method, are presented for consideration in the design and production of "difficult to form" sheet metal components. (auth)

16005 (AMC-TR-60-7-764) PRODUCTION OF EXTRUSION BILLETS OF HIGH TEMPERATURE AIRCRAFT ALLOYS BY POWDER METALLURGY. Final Technical Engineering Report, June 1, 1959-September 15, 1960. M. W. Toaz, G. F. Davies, and R. D. Johnson (Clevite Corp. Mechanical Research Div., Cleveland). Dec. 1960. Contract AF33(600)-39327. 111p.

High-temperature super alloys, Rene' 41 and PH 15-7 Mo, for high-performance aerospace vehicle structures can be economically extruded from powder metal billets. Hydrostatic compaction was determined as the available method best suited for large billet (1.5 in. diam. and larger) preparation and the density and mechanical properties of the powder metal extrusions were within 5% of wrought metal at room temperature. (auth)

16006 (ANL-6177) A REPORT ON SOME ATTEMPTS TO CAST CENTRIFUGALLY FUEL ELEMENTS OF SMALL DIAMETER. F. L. Yaggee (Argonne National Lab., Ill.). Mar. 1961. Contract W-31-109-eng-38. 22p.

The applicability of the centrifugal casting technique to the production of multiple castings of fuel pins of small diameter and of thin fuel plates was investigated. Fuel pins measuring 0.185 in. in diameter by 4¼ in. long of unalloyed uranium and of a uranium-2 wt.% zirconium alloy were cast successfully in batches of sixteen pins per melt. Sixteen different metals and alloys were used as mold materials. Smaller and longer fuel pins, 0.165 in. in diameter by 9¾ in. long, of similar compositions were cast successfully in brass and copper molds. Thirty-six pins of the same diameter and length were cast simultaneously in each casting run. Attempts to cast centrifugally thin uranium plates measuring 9 in. long by 2 in. wide by 0.04 in. thick proved to be only partially successful, but encouraging. These plates were cast into graphite molds at the rate of six plates per run. The maximum usable length of the unalloyed uranium plates cast did not exceed six inches. (auth)

16007 (ATL-A-117) DEVELOPMENT OF CLAD CERAMIC FUEL PLATES BY SPRAY-COATING TECHNIQUES. Quarterly Technical Progress Report, January-March 1961. (Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.). Contract AT(04-3)-250. Project Agreement No. 4. 20p.

The development of plasma-jet spray-coating techniques for producing clad ceramic fuel plates is discussed. Conditions for spraying fused UO_2 powder were established by depositing cones on stationary substrates. It was found that the arc-gas flow range within which deposition occurs is very narrow. Coatings were made from -200 +325, -270 + 325, and de-slimed -325 mesh fused UO_2 powders. To provide data regarding the economics of the process, deposition rates and efficiencies were determined under various conditions. The effects of powder size, power input, arc-gas flow rate, spray distance, traverse rate, power feed rate, powder-gas flow rate, and cover-gas flow rate on deposition efficiency are discussed. Oxygen-to-uranium ratios of coatings made for evaluation of density were determined by gravimetric and volumetric methods. Preparation of the surface without distortion for plasma spraying is discussed. Fixturing and instrumentation methods were designed for measuring substrate and coating temperatures during spraying of typical fuel-element-cladding thicknesses of stainless steel and Zircaloy-2. (M.C.G.)

16008 (ATL-A-119) INVESTIGATION OF THE TECHNICAL FEASIBILITY OF COLD EXTRUSION FOR ZIRCALOY-2 TUBING PRODUCTION. Quarterly Technical Progress Report, January-March 1961. (Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.). Contract AT(04-3)-250, Project Agreement No. 7. 13p.

Lubrication systems composed of a lubricant and a con-

version coating were developed and evaluated for the cold extrusion of Zircaloy-2. A fluoride-phosphate base coating and several lubricants were selected for actual extrusion tests. Bars of Zircaloy-2 were successfully extruded at temperatures ranging from room temperature to 400°C using reductions of 50, 65, and 80%. Excellent surface finish was obtained and no evidence of cracks or other defects could be found. Fully annealed, extruded specimens exhibited the same tensile properties as similarly treated raw bar stock. Preferred orientation was found to be the same as for hot-extruded tubing, and corrosion in 750°F, 1500-psi steam was the same as for raw bar stock. Billets were pierced successfully using reductions of up to 80% at 300°C. A 140-degree conical punch profile was found to provide the best surface and require the lowest pressure. Open-end tubes were successfully extruded with maximum reductions of 80% and final wall thickness down to 0.044 in. A preliminary analysis of the economic potential of this process for Zircaloy-2 tubing production showed that it is economic if sufficient production volume exists. (auth)

16009 (DMIC-Memo-98) ELECTROPOLISHING AND CHEMICAL POLISHING OF HIGH-STRENGTH, HIGH-TEMPERATURE METALS AND ALLOYS. J. A. Gurklis, L. D. McGraw, and C. L. Faust (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Apr. 12, 1961. 16p. (PB-161248)

Chemical polishing and electropolishing of metals are discussed and contrasted with mechanical operations. Methods are given for electropolishing stainless steel, Ni and Cr alloys, Be, Ti and its alloys, Nb, Ta, V, and W. Procedures are also given for chemical polishing Ti, Ta, and Nb. (M.C.G.)

16010 (KAPL-M-JDC-3) EVALUATION OF A. O. SMITH SERIES SUBMERGED ARC OVERLAY CLADDING ON ASTM GRADE A212 STEEL. J. D. Carey (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 7, 1961. Contract W-31-109-Eng-52. 7p.

Inconel-type overlay plates were series submerged arc clad with INCO 52 (Techalloy) wire and A. O. Smith proprietary flux, and deposits were made on ASTM grade A212 and A302 steels. It was found that the overlay meets easily the requirements of NAVSHIPS 250-1500-1 for welded overlays, that the iron content of the second and third layers is high (~13 or 14%) but still satisfactory, and that the resistance to salt water chloride stress corrosion cracking is less than that of wrought Inconel. (D.L.C.)

16011 (MND-E-2489) WELDING SPECIFICATIONS FOR ANPP CORROSION PROGRAM TEST HEAT EXCHANGERS (INCONEL, MONEL AND NICKEL). (Martin Co. Nuclear Div., Baltimore). Mar. 8, 1961. Contract DA-44-009-ENG-3581. 24p.

Developmental welding was performed in conjunction with fabrication of heat exchangers for the ANPP Corrosion Test Program. Satisfactory processes were developed for: (1) overlaying carbon steel tube sheet material with Inconel, Monel and nickel; (2) seal welding Inconel, Monel and nickel heat exchanger tubes to their respective tube sheets; and (3) seal welding clad tube sheets to the primary shell. Specifications for these welds are included. (auth)

16012 (NMI-7236) POWER REACTOR PROGRAM. Progress Report to Savannah River Operations Office, United States Atomic Energy Commission for the Period January 1, 1961 through January 31, 1961. S. Isserow, A. M. White, E. F. Jordan, W. J. Richmond, W. L. Larson, P. R. Smoot, H. M. Green, A. R. Gilman, and W. B. Tuffin (Nuclear Metals, Inc., Concord, Mass.). Mar. 24, 1961. Contract AT(30-1)-1565. Sponsor Agreement No. S-31. 42p.

An analysis was made of the cladding thickness of various tubes. Experiments showed that small changes in the cooling rate following beta treatment of tubes influence the final grain size of the cores. A summary of cladding thickness data obtained by autoradiography and eddy current for the inner tubes of the demonstration set shows that the cladding is everywhere at least 20-mils thick. As the result of brazing trials on dingot specimens it appears that directional solidification will be necessary to eliminate voids. Samples of a U–0.3 wt.% Al–0.5 wt.% Si alloy solutionized before extrusion were examined metallographically in different conditions. By oil quenching after gamma treating, precipitation of the dispersed phase was prevented; subsequent aging caused a fine precipitated phase to appear. Bond integrity was good for samples in the as-extruded and beta treated conditions and poor for all gamma treated specimens whether air cooled or oil quenched. Cracks are found in the U–0.3 wt.% Cr–0.3 wt.% Mo alloy as cast and after subsequent operations. The grain size of a U–0.4 wt.% Al (nominal U–0.6 wt.% Al) casting is too coarse to give a satisfactory core-cladding interface and triple beta treatment did not seem to reduce grain size sufficiently. In the study of the penetration of magnesium and of Mg–0.4 wt.% Si alloy in Zircaloy, sandwich-type couples give fairly uniform and reproducible values at 500°C if the components of the couple are etched before assembly. Penetration rates are about the same for pure magnesium and for the alloy at 500°C. Tensile specimens through the diffusion zone of couples treated at 500°C broke on the Zircaloy side of the original interface at values of 5,000 to 5,500 psi (as compared to 12,000 psi for magnesium). In bend tests on Zircaloy tubes coated by dipping in molten magnesium, cracks originated in the magnesium, progressed radially to the bond zone and then propagated circumferentially. Uranium cores of coextruded Zircaloy-clad tubes were melted in situ. When heating was controlled at the melting point of uranium or 15°C above, the cladding thickness decreased no more than 0.4 mils, and the formation of an interfacial zone appeared to degrade the ductility of the bond. Diameters increased as the result of melting and there were shrinkage voids at the zones that were melted last. Bowing occurs but there is evidence that it can be controlled by proper support. (auth)

16013 (NOR-61-66) DEVELOPMENT OF EXTRUDED BERYLLIUM SHAPES. Interim Engineering Report No. 11, December 1, 1960 through February 28, 1961. (Norair. Div. of Northrop Corp., Hawthorne, Calif.). Contract AF33 (600)-36931. 13p.

A summary is given of the progress of the beryllium extrusion program. The major problems of beryllium extrusion were investigated. The feasibility of unclad beryllium extrusions was demonstrated, but additional work was considered necessary to perfect extrusion methods to the degree where a full 20 feet of defect free section could be reliably and repetitively fabricated. Ten to twelve-foot lengths of defect free material were produced occasionally. The most recent efforts were directed toward the development of the full 20 feet and the extrusion from Push No. 135 resulted in a 26-foot long extrusion with only a few defects. This represents the longest extrusion to date. It was not possible to establish a reasonable degree of consistency and this lack of consistency was attributed to the rather low top speed of the press. Because of this, arrangements were made to have an exploratory extruding effort performed with a newer and more adequate press. After

eview of a number of possible extruding facilities, planning f adequate toxicity safeguards, and adaptation of tooling to new press, extruding efforts were made. The first series f efforts showed considerable promise of satisfactory re- ults. Later efforts were not so successful. (auth)

6014 (NP-9975) RESEARCH STUDY FOR DEVELOP- IENT OF ALUMINUM BASE ALLOYS BY POWDER MET- ALLURGY TECHNIQUES. Second Quarterly Progress Re- ort, December 1, 1960–February 28, 1961. S. G. Roberts Kaiser Aluminum and Chemical Corp., Spokane). Mar. 22, 1961. Contract DA-04-200-507-ORD-886. 9p. (MS PR 31-30)

Tensile properties were determined for alloys containing 5.0 to 7.5% Mn with Mg, Ti, V, and Zr additions, and alloys containing 7.5% Mg with Cr and Mn additions. On the basis of the property determinations, the compositions consisting of: Al–5.0% Mn–1.5% Zr; Al–5.0% Mn–0.75% Ti–0.75% Zr; Al–7.5% Mg–1.5% Mn–0.50% Cr; and Al–7.5% Mg–1.0% Mn–0.25% Cr, were selected for determination of cold working characteristics. The properties as well as the constituents of each specimen tested are tabulated. (B.O.G.)

16015 (NUMEC-P-50) DEVELOPMENT OF PLUTO- NIUM BEARING FUEL MATERIALS. Progress Report, October 1 through December 31, 1960. (Nuclear Materials and Equipment Corp., Apollo, Penna.). Contract AT(30-1)-2389. 35p.

Equipment installation into the glove boxes was emphasized during the quarter. Final safety reviews, inspections, and trial operations with cold materials are in progress. In other work, the effects of initial feed solution, nitric acid or ammonium nitrate concentration on ADU and final UO_2 powder properties were examined. Data from sintering experiments indicate that the bulk powder properties differ considerably from those produced with excess nitric acid and those with excess ammonium nitrate in the feed stream. Studies involving the determination of boron and other trace impurities in Pu were extended to a comparison of a flame photometric technique for boron with the spectrographic method and to evaluate the recovery of boron after anion resin separation. Effort in other areas was devoted largely to installation and check-out of machinery and equipment for thermal conductivity measurements, metallographic studies, and fuel reprocessing. (J.R.D.)

16016 (NYO-9061) FUEL ELEMENT DEVELOP- MENT PROGRAM FOR THE PEBBLE BED REACTOR. Quarterly Progress Report, May 1, 1960–July 31, 1960. (Sanderson and Porter, New York). Contract AT(30-1)-2378. 48p.

Fabrication of alumina-coated UO_2 and pyrolytic carbon-coated UC_2 particles was studied. Some reaction was noted between alumina and graphite at 2500°F. For UC_2 particles coated with carbon at 2000°F, the coatings were found to crack at temperatures above 2000°F, whereas 2450°F deposition gave fewer failures at 3600°F, more rapid deposition rates, and absence of excess soot formation. A Pebble Bed Reactor fuel element consisting of a 1.5-in. graphite sphere fueled with alumina-coated UO_2 particles was irradiated at 1400°F to a burnup of 3.3 at. % U^{235}. Up to 2.5 at. % burnup, the fission product leakage factors (rate of release/rate of production) ranged between 10^{-8} and 10^{-5} for 10 isotopes and were ascribed to trace amounts of uranium contamination outside the particle coatings. In the latter part of the quarter, the leakage factor for Xe^{133} rose to 10^{-3} while several other shorter lived fission products increased to a smaller extent, indicating the beginning of diffusion through the coatings due to radiation damage of the alumina. Carbon-coated UC_2 particles coated at 2000°F were found to have good fission product retention up to 2000°F, and less than 4.5×10^{-6} of the Xe^{133} was released in a 4-hr test. Graphite bodies of density >2.0 g/cm^3 were prepared using natural graphite powder as filler material, and their crushing strength was on the same order as that of AGOT synthetic graphite. (D.L.C.)

16017 (NYO-9328) BIMETALLIC CASTING. Quarterly Progress Report No. 1, June 1, 1960–February 28, 1961. David Krashes (Worcester Polytechnic Inst., Mass.). Mar. 29, 1961. Contract AT(30-1)-2557. 12p.

Cylindrical couples, consisting mostly of Cu cores and steel clads, were used to evaluate the equipment available for cladding Zr on U and to develop direct casting techniques. Experiments consisted of induction melting the core and clad materials simultaneously in attempts to achieve metallurgical bonding. Bonding of equivalent strengths was produced between the steel and Cu when both were molten at the interface and when the copper alone was molten at the interface. Methods were developed for measuring temperature during melting and for keeping the center of the core solid while its surface was molten. A vacuum induction furnace was designed and constructed for the bimetallic casting of U and Zr. (auth)

16018 (SB-454) HEAT TREATMENT OF METALS. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Feb. 1961. 19p.

The 208 reports listed in this bibliography on heat treatment of metals were added to the OTS collection during the period 1950 to March 1961. (auth)

16019 (SB-60-41) THE FABRICATION OF MOLYB- DENUM. An Annotated Bibliography. Maureen A. Pearcy, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Dec. 1960. 48p.

A survey is presented of recent literature on the fabrication of molybdenum and molybdenum alloys, particularly those alloys containing 0.5% titanium. The aspects of producibility that were covered include: rolling and forming, welding and brazing, riveting, shearing, and spinning. The majority of literature cited was published since 1958. 123 references. (auth)

16020 (TID-12501) EXPLOSIVE FORMING OF MET- ALS. F. C. Polhemus (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Mar. 24, 1961. Contract W-7405-eng-26. 30p.

Paper presented at the Southern Metals Conference, American Society for Metals, in Atlanta on Apr. 24-26, 1961.

The history and fundamentals of explosive forming of metals are discussed. The various types and forms of explosives available are described. The high explosives are more commonly used for explosive forming of metals than low explosives. The differences in contact and stand-off charges are reviewed. Metal forming speeds associated with explosive forming range between 200 and 400 ft/sec. Some of the jobs applicable to explosive forming are direct forming with high explosives, direct forming using low explosives, punching, welding, engraving, bulge testing of welds, compaction of metallic and ceramic powders, surface hardening, swaging, and fastening. The advantages and disadvantages of explosive forming in comparison with conventional practices are discussed. (M.C.G.)

16021 (AEC-tr-4530) METALLIC MEMBRANES: SILVER MEMBRANES. F. A. Santalov and R. E. Neyman. Translated from Kolloid. Zhur., 3: 273-80(1937). 12p.

Silver membranes were prepared from Ag–Zn alloys by the vaporization of zinc in a vacuum in order to determine the relationship between the preparative conditions and the porosity of the silver membranes and to find a satisfactory

method for evaluation of the total pore volume of these membranes. The dependence of porosity of the membranes on the duration of their treatment in vacuum at temperatures from 650 to 700°C and times from 20 min. to 6 hr. was studied. Before and after treatment the membranes were weighed, and using hydrostatic weighing their volume was determined. The radii of the pores were measured by Bechhold's method. The number of pores for a unit membrane surface was calculated to be between 10^6 and 10^8 pores per 1/3 cm^2. The effects of recrystallization processes on the pore volume are discussed. Membranes with finer pores were obtained from alloys with a smaller initial zinc content and on treatment of not more than 3 hr. (M.C.G.)

16022 (NP-tr-593) SEIZING OF METALS. A. P. Semenov. Translated from p.46-101; 231-52 of "Skhvatyvaniye Metallov", Moscow, 1958. 141p.

A translation of two chapters is presented. In the first (chap. II), a review is given of the technology concerning metal seizing when worked by pressure and cutting. The following chapter covers the role of seizing in the technological processes of solid phase bonding of metals. Included are sections on pressure- and cold-welding of metals, deformation diagrams for cold-welding, ultrasonic welding, aluminum alloy cladding, powder metallurgy and recrystallization and diffusion hypotheses of seizing. (J.R.D.)

16023 THE ELECTROLYTIC OBTENTION OF DEFINITE U_3O_8 AND ZINC LAYERS ON A NICKEL PLATE IN A PLASTIC VESSEL. U. Drehmann (Kernphysikalisches Institut Zeuthen, Deutsche Akademie der Wissenschaften, Berlin). Kernenergie, 3: 1202-3(Dec. 1960). (In German)

For the electrolytic obtention of thin metal or oxide films, a plastic vessel was developed in which surfaces of various dimensions could be covered on one side. The preparation of films of U_3O_8 and zinc is described. (tr-auth)

16024 THE FORMING OF HOLLOW SHAPES IN BERYLLIUM BY LOOSE SINTERING AND HOT PRESSING. A. J. Martin, R. A. Knight, and G. C. Ellis (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Powder Met., No. 7, 268-82(1961).

Two methods for forming shaped bodies in beryllium by powder metallurgy are described and compared. The requirements for uniform densification during hot pressing are discussed, and it is concluded that a double-pressing method is essential if thin-walled hemispherical shapes are required. (auth)

16025 FUEL ELEMENTS FOR NUCLEAR REACTORS. (to DEGUSSA). Belgian Patent 571,786. Priority date, Oct. 16, 1957. (In French)

The fuel is UC or PuC. Between can and fuel, a protective layer constituted by a mixture of SiC and Si is pressed onto the fuel rod. Several protective layers can be used together with a metallic bond to the fuel, 5 to 15% in weight. (EURATOM)

16026 NEW CANNING PROCESS AND EQUIPMENT. M. Gauthron and G. Beernaert (to Commissariat a l'Energie Atomique). Belgian Patent 573,642. Priority date, Dec. 19, 1957. (In French)

The can is applied on the fuel element by passing through a die having a diameter larger than the fuel element. The required conditions are: inert atmosphere, high temperature of the can, and the introduction of a liquid or a solid as a bond between can and element. It is claimed that no alteration of the size or shape of the element can be found after canning. (EURATOM)

16027 MANUFACTURING PROCESS FOR NUCLEAR MATERIALS AND FUELS. (to Office National d'Etudes et de Recherches Aeronautiques). Belgian Patent 575,534. Priority date, Feb. 14, 1958. (In French)

Uranium-base fuel is combined with plastic chromium for improved oxidation resistance, strength, ductility, and thermal conductivity. Chromium can be incorporated into a metal matrix by high-temperature sintering of chromium or chromium alloy powder with UO_2 powder or U_3O_8 granules. It can also form a metal coating, applied by metalizing under vacuum or argon atmosphere or by schoop plating with chromium alloys followed by a diffusion treatment in a halogen atmosphere. The process applies to uranium carbide or nitride fuels. Several metals, such as iron, nickel, molybdenum, zirconium, and aluminium, can be added to the chromium matrix. A preferred composition is 22% Cr, 9% Mo, 15% Fe, 54% Ni. The chromizing process is also applicable to sintered control rods and to moderator materials containing beryllium oxide. (EURATOM)

16028 MANUFACTURE OF FUEL ELEMENTS FOR NUCLEAR REACTORS. (to Societe Belge pour l'Industrie Nucleaire). Belgian Patent 584,990. Nov. 25, 1959. (In French)

Instead of extruding fuel elements or using sintered powders, the inventors put powdered fuel in a cylindrical can and submit it to ultrasonic vibrations. It is claimed that a density of 8.5 can be achieved with UO_2 powder with an ultrasonic frequency of 35 kc. (EURATOM)

16029 PROCESS FOR THE PREPARATION OF MODERATOR GRAPHITE FOR USE IN NUCLEAR REACTORS. (to Shell Internationale Research Maatschappij N. V.). British Patent 862,221.

A process is given for preparing reactor grade graphite from petroleum coke. In this process, the coke is ground and worked up with a binder to form shaped pieces which are graphitized at 2500 to 3000°C and then impregnated with a densifier to fill the pores. The impregnated pieces are again subjected to heat treatment at 2500 to 3000°C, resulting in dense shaped products. The binder and densifier are prepared from petroleum distillates (preferably those subjected to cracking treatment) by treating with an oxygen-containing gas at 150 to 400°C until the Ring and Ball softening point is 80 and 70°C for the binder and densifier, respectively. Volatiles remaining in the treated petroleum distillates should be removed by distillation before the graphitizing treatment. Three examples of binder and densifier preparation are given. (D.L.C.)

16030 IMPROVEMENTS IN OR RELATING TO PRODUCTION OF URANIUM METAL. Malcolm Douglas Jepson and Gerard Slattery (to United Kingdom Atomic Energy Authority). British Patent 863,492. Mar. 22, 1961.

A method is given for treating uranium to render it adaptable to grain refinement by heat treatment to the degree that its surface will not roughen unduly under irradiation. This method consists of adding 200 to 500 ppm iron and 500 to 1200 ppm aluminum to uranium. Such additions can be made by melting a magnesium-reduced uranium billet with uranium–3% aluminum alloy and iron strip in a graphite crucible by h-f induction heating. The melt is poured into alumina-lined steel molds and cooled. Beta quenching and alpha annealing then give a product with a peripheral grain structure refined by a factor of 6 to 30 from the largest initial grain size of ~2.0 to 3.0 mm. (D.L.C.)

16031 IMPROVEMENTS IN OR RELATING TO EQUIPMENT FOR WELDING METAL TUBES, RODS OR THE LIKE. John Brian Byford Mills (to General Electric Co., Ltd.). British Patent 863,554. Mar. 22, 1961.

Welding equipment designed for the automatic or semi-omatic welding of small-bore metal tubes or rods is de-ibed. The equipment comprises a supporting framework ich includes a clamping means for the tubes or rods and annular member adapted to carry a plurality of welding ctrodes or torches. An electric motor is secured to the mework and arranged to drive the annular member and s rotate the welding electrodes around the tubes or rods. L.C.)

032 POROUS MEMBRANES AND METHODS OF ANUFACTURING THESE MEMBRANES. (to Commis-riat a l'Energie Atomique). British Patent 863,744. ar. 29, 1961.

A method is given for manufacturing porous membranes ich is a simpler version of that disclosed in Patent No. 9,837. In this method, a Teflon powder (preferably No. 6, ich has a grain size of ~0.3 μ) is mixed with alcohol or me other wetting agent to form a paste which can be ap-ied on a corrosion-resistant metal fabric; the alcohol is en eliminated by drying. Before the paste is applied on e fabric, it may be subjected to an aging treatment to im-regnate the Teflon more thoroughly. (D.L.C.)

033 IMPROVEMENTS IN AND RELATING TO OXI-ATION RESISTANT ARTICLES. (to Union Carbide Corp.). ritish Patent 865,320. Apr. 12, 1961.

A method is given for treating carbon and graphite arti-es to increase their oxidation resistance at 500 to 950°C. he method consists of forming a protective coating of mol-n zinc phosphate on the articles, and such coating may be complished by impregnating or incorporating into the rticles a mixture of $(NH_4)_2HPO_4$, $ZnCl_2$, and H_3BO_3 in a eight ratio from 4:1:0 to 2:2:0.25. The mixture may be the form of a 1.5% HCl aqueous solution, in which case e preferred weight ratio is 3:1:0.25. After the mixture incorporated into the articles, the articles are heated to rm the protective coating. Oxidation data are presented r a variety of treated carbon and graphite samples at 500 725°C. (D.L.C.)

Properties and Structure

6034 (AD-244305) PARAMETRIC STUDIES OF METAL FIBER REINFORCED CERAMIC COMPOSITE MA-TERIALS. Bi-Monthly Report No. 4, July 8, 1960 through September 7, 1960. Elbridge Z. Stowell and Tien-Shih Liu Southwest Research Inst., San Antonio). Sept. 8, 1960. Contract NOas 60-6077-c. 11p.

The mechanical behavior of ceramic materials at ele-rated temperatures is described from a phenomenological standpoint. The viscoelastic characteristics of both the ceramic materials and the metals at elevated temperatures makes possible the prediction of their behavior. Summary ables on pertinent physical, mechanical and thermodynamic properties are presented for carbides, nitrides and borides. (auth)

16035 (AD-245862) THERMOELECTRIC POWER GENERATION AND RELATED PHENOMENA. Bimonthly Report No. 9, May 7, 1960–July 7, 1960. (Battelle Memo-rial Inst., Columbus, Ohio). Aug. 30, 1960. 21p.

Alloy ingots of nominal composition, 80 GaAs–20 AlAs, were prepared by zone leveling and crystallization from solution. Measurements were made of electric conductivity, Hall coefficient, and thermoelectric power of the materials as a function of temperature to 742°C. Work was continued in the measurement of thermal diffusivity in InSb for the bolometric effect occurring when the material is exposed to a radiation beam. The measurements yielded values which differed by an order of magnitude from calculated and previously reported values. A method utilizing the temperature wave amplitude at the back surface of the illuminated portion resulted in thermal diffusivity values in reasonable agreement with the calculated and reported values. (B.O.G.)

16036 (AD-245907) THERMOELECTRIC MATERIALS. Bimonthly Progress Report No. 2, March 1, 1960–April 30, 1960. Henry E. Wenden, S. R. Ali Zaidi, and Thomas S. Shevlin (Ohio State Univ., Research Foundation, Columbus). May 4, 1960. Contract Nobs-78254. 5p.

A study was conducted to determine the variation of emf with time for $Na_2O \cdot 6V_2O_5$ under atmospheres of helium, hydrogen, and oxygen. It was concluded that the hot-end state (H) more nearly approaches V^{5+} and attendant coordination, while the cold-end state (C) approaches V^{4+}. The reducing atmosphere at the hotter end of the melt tends to change state H to that of state C, with the evolution of oxygen. The atmosphere-dependent tendency to change the energy state results in lowering the energy difference between excited electrons in the hot and cold ends and hence in reducing the flow of electrons. (B.O.G.)

16037 (AERE-M-819) HIGH TEMPERATURE X-RAY DIFFRACTION STUDIES. PART II. URANIUM MONOCARBIDE AND URANIUM DICARBIDE. I. F. Ferguson, R. S. Street, and T. N. Waters (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 1961. 8p.

A high-temperature x-ray-powder-diffraction study was made of uranium monocarbide ($UC_{0.83}$) and uranium dicarbide ($UC_{1.82}$). The cube cell edge, a_t, of $UC_{0.83}$ at a temperature t°C is given by the relation: $a_t = 4.9592\ [1 + (10.98 \pm 0.08) \times 10^{-6}\ t]$ A, 20° < t° < 690°. For $UC_{1.83}$, the dimensions of the tetragonal unit cell, a_t and c_t, at a temperature t° were given by the relations: $a_t = 3.5256\ [1 + (16.56 \pm 0.23) \times 10^{-6}\ t]$ A and $c_t = 6.0014\ [1 + 10.43 \times 10^{-6}\ t]$ A, 20° < t° < 935°. (auth)

16038 (AERE-R-3598) A MERCURY COMPUTER PROGRAMME FOR THE ANALYTICAL REFINEMENT OF CRYSTAL UNIT CELL PARAMETERS BY THE METHOD OF LEAST SQUARES. E. Wait (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 1961. 9p.

A Mercury program in Autocode which calculates accurate crystal unit cell parameters from the Miller indices and observed Bragg angles of x-ray diffraction lines is described and notes on its use are given. In its present form the program can be used for the cubic, tetragonal, and hexagonal systems. The extrapolation function derived by Nelson and Riley for the Debye-Sherrer method is used and, in addition to the unit cell parameters and their standard deviations, the drift constant D, which is a measure of the systematic errors is calculated. Up to 62 planes and 8 different x-ray wavelengths may be used. (auth)

16039 (AFOSR-284) THE OPTICAL AND ELECTRICAL PROPERTIES OF SINGLE CRYSTAL TELLURIUM. (Minneapolis-Honeywell Regulator Co. Ordnance Div., Hopkins, Minn.). Aug. 31, 1960. 36p.

A study was made of the temperature dependence of the mobility of holes in tellurium by measuring the electric resistivity and Hall coefficients from 77 to 300°K. An interpretation is given of an investigation of the non-vanishing galvanomagnetic coefficients of tellurium at 4.2°K. Measurements were made to determine recombination processes in several tellurium samples. The results of optical activity measurements of tellurium at room temperature are shown

graphically where the rotary power, Θ/d is plotted as a function of the wave number, $\bar{\nu}$, from 0.14 to 0.26×10^4. It is noted that Θ/d is linear for $10^4\ \bar{\nu} < 0.20$. (B.O.G.)

16040 (ARF-2191-6) IMPROVED VANADIUM-BASE ALLOYS. Final Report, December 1, 1959–November 30, 1960. B. R. Rajala and R. J. Van Thyne (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Dec. 27, 1960. Contract NOas 60-6056-c. 36p.

Vanadium-niobium base alloys exhibiting an excellent combination of fabricability, weldability, and strength up to 2200°F were investigated. Alloying behavior was evaluated in neutral atmospheres by room-temperature, 2000, 2200, and 2400°F tensile tests and by 2000°F stress-rupture data. Titanium in amounts of 5 wt.% proved to be a better solid solution strengthener of the V-Nb base than either hafnium or zirconium. The strongest alloy investigated was V-60 wt.% Nb with an ultimate tensile strength of approx 63,000 psi at 2000°F; V-5 wt.% Ti-20 wt.% Nb exhibits a tensile strength of 50,000 psi at this temperature. The data compare favorably with the strength of the strongest sheet materials at 2000°F. With no post-welding heat treatment, welded sheet of V-5 wt.% Ti-20 wt.% Nb passed a 180°, 3t bend test. The recrystallization temperature of vanadium was raised 700°F with carbon additions, and 800°F with boron additions. An alloy V-5 wt.% Ti-20 wt.% Nb-0.25 wt.% C had a 100-hour 2000°F stress-rupture strength of 6000 psi. (auth)

16041 (BAW-145(Pt.I)) CHEMICAL AND PHYSICAL PROPERTIES OF HEAVY AND LIGHT WATER. I. PHYSICAL PROPERTIES. S. R. Protter (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). May 1959. 37p.

A compilation of the best available data on the physical properties of light and heavy water is presented. (J.R.D.)

16042 (BM-RI-5757) THERMAL EXPANSION OF ALPHA ALUMINA. William J. Campbell and Clark Grain (Bureau of Mines, College Park, Md.). July 1960. 16p.

Thermal expansion measurements were made, using a high-temperature x-ray diffractometer, on alpha-alumina to determine the characteristics to 1200°C. Results are given in graphical and tabular forms. It was concluded that alpha alumina expands anisotropically with the expansion coefficient parallel to the c axis, approximately 10% higher than the coefficient parallel to the a axis. (B.O.G.)

16043 (CF-60-12-119) DISPERSION STRENGTHENING OF IRON–ALUMINUM BASE ALLOYS: A FEASIBILITY STUDY. Blake King (Oak Ridge National Lab., Tenn.). Dec. 27, 1960. 44p.

The feasibility of improving the mechanical properties at 1700 to 1800°F of oxidation-resistant Fe–Al–Cr alloys by means of a refractory dispersion was explored. A literature search was conducted, preliminary experimental determinations of properties of the alloy and its oxides were carried out, and certain mathematical relations between dispersion characteristics and metallurgical variables were derived. The results indicate that the alloys can be strengthened sufficiently by using a dispersion with an interparticle spacing of about 2 to 3 μ. High-temperature native oxides of the Fe–Al–Cr alloy consist largely of Al_2O_3 and in theory would serve as a satisfactory second phase. (auth)

16044 (CRFD-999) GRAIN GROWTH IN SINTERED URANIUM DIOXIDE. J. R. MacEwan (Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.). Jan. 1961. 15p. (AECL-1184)

Grain growth was investigated in a UO_2 sinter of 94 per cent theoretical density over the temperature range 1555 to 2440°C. The results were in close, but not exact agreement, with a theoretical expression describing grain growth in polycrystalline matrix. For the material studied, the me grain diameter D (μm) after annealing for t hours at a te perature T (°K) was given by the equation $D^2 - D_0^2 = k_0 t^{0.5} e$ (−87,000/RT), where D_0 and k_0 are respectively the initia grain size and a proportionality constant. Uranium metal was found in all samples annealed at over 2000°C. This w taken as evidence that the UO_2 lattice can be oxygen-defic at high temperatures. (auth)

16045 (DMIC-Memo-92) STRESS-RUPTURE STRENGTHS OF SELECTED ALLOYS. D. P. Moon and W. F. Simmons (Batelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Mar. 23, 1961. 5p.

Curves are given for stress as a function of temperatu for rupture in 100 and 1000 hr for selected alloys, at stresses to 70,000 psi, and 300 to 2500°C. (B.O.G.)

16046 (HW-61898) QUALITY STANDARDS AND TES FOR SWAGED FUEL CLADDING. R. E. Olson (General Electric Co. Hanford Atomic Products Operation, Richla Wash.). Sept. 10, 1959. 5p.

Cracking of Zircaloy cladding by the cold work induced swaging was investigated. Two feeding devices were constructed to control the rate of translation and rotation of the rod during swaging. The first several batches of rods swaged and tested by fluorescent penetration had reject rates from 50 to 75%. However further investigation showed that the cause of the problem was the incoming tubing and not the swaging process. More than 60% of the incoming tubing showed some indications of pits, cracks, galling, and other defects. It was found that the swaging did not propagate and in some cases lessened their severity by reducing their depth. Tubes with no cracks before swaging were found to be defect-free after swaging. (M.C.G.)

16047 (MRC-195) PERMEABILITY OF CLADDING MATERIALS TO INERT GASES. Annual Report No. 2, November 15, 1959–November 15, 1960. G. T. Murray (Materials Research Corp., Yonkers, N. Y.). Nov. 15, 1960. Contract AT(30-1)-2286. 32p.

Diffusivities of helium through aluminum were measured at 325 to 550°C by ionization techniques. An aluminum sheet cathode was charged with gas by bombarding it with helium ions accelerated by 500v d-c potential. Two charge strips were bonded to form a diffusion couple such that the helium was contained in a thin center section. The gas was subsequently allowed to escape during an isothermal anneal Diffusivities evaluated from the measurements yielded the relation: $D = 5.3 \times 10^{-5} \exp(-16{,}000/RT)$. Helium was generated in aluminum containing approx 0.1 at. % lithium by transmutation of the Li^6 atoms during neutron irradiation. Metallographic examination after subsequent heating of the irradiated specimens revealed that the helium had precipitated in the form of small cavities. Utilizing a dislocation etch pit reagent, it was found that the highest cavity density always occurred in the region of highest dislocation density. A series of cavities appeared to delineate the track of a moving dislocation. In regions of low dislocation density a cavity was often associated with a dislocation etch pit. It is believed that helium precipitates along the dislocations in the form of continuous or semi-continuous cavities. (auth)

16048 (NAA-SR-6095) VAPORIZATION OF ZIRCONIUM OXIDE. M. M. Nakata, R. L. McKisson, and B. D. Pollock (Atomics International. Div. of North American Aviation Inc., Canoga Park, Calif.). Apr. 15, 1961. Contract AT(11-1)-Gen-8. 10p.

he vaporization rate of zirconium oxide at 2410 to
)°K was measured using the Knudsen effusion technique,
the composition of the vapor was estimated from a
ss spectrometric observation. These data were used,
n pertinent thermodynamic quantities obtained from the
rature, to calculate the dissociation energies D: (ZrO) =
± 0.2 ev, and D: (ZrO_2) = 14.9 ± 0.2 ev. (auth)

49 (NAA-SR-Memo-5167) ORGANIC COOLANT–
COMPATIBILITY. J. E. Kinzer and A. N. Mellott
omics International. Div. of North American Aviation,
., Canoga Park, Calif.). Apr. 12, 1960. 25p.
ests were run to determine whether an organic coolant
uld repetitively penetrate to cracks and voids in UO_2 fuel
ing periods of alternating high and low temperature op-
tion. A study was also made to determine, if penetration
re repetitive, whether carbon would progressively stress
l damage the cladding or if equilibrium of stresses would
ntually be achieved. Relatively large defects were made
the cladding of the test specimens during fabrication. It
s concluded that the organic coolant at reactor tempera-
es does penetrate swaged UO_2, small cracks in UO_2 pel-
s, and to some extent, dense UO_2 pellets. Carbon was
med by pyrolytic decomposition of the organic material
all regions into which it penetrated that were above its
composition temperature. The organic penetration was
petitive during each low-temperature portion of the cy-
ng. This filling and decomposition led to failure of the
nulated fuel rod from stresses caused by carbon forma-
n. (M.C.G.)

050 (NMI-1242) DEFORMATION MODES OF SIN-
LE CRYSTAL URANIUM DIOXIDE FROM 700°C TO
00°C. E. J. Rapperport and A. M. Huntress (Nuclear
etals, Inc., Concord, Mass.). Aug. 24, 1960. Contract
T(30-1)-1565. 29p.
Single crystals of uranium dioxide were deformed in
mpression at 700 to 1900°C. The most active slip plane
all temperatures was {100}, with {110} and {111} becoming
ore active as the temperature was increased. The slip di-
ection for {100} slip was determined as <110>. Fracture
curred on {111} planes with a single instance of {110}
acture being observed. Estimates of the relative magni-
ides of the critical resolved shear stresses were calcu-
ted by bracketing stress values for active and dormant
lip planes. (auth)

6051 (NP-9892) RARE EARTH INTERMETALLICS.
i-Monthly Report No. 1, November–December 1960.
Nuclear Corp. of America. Research Chemicals Div.,
urbank, Calif.). Contract NOw-61-0257-c. 21p. (RC-
37)
A program to investigate the intermetallic compounds of
are earths to screen materials showing promise for uti-
zation at elevated temperatures was begun. Crystal
tructure, thermal properties, and corrosion rates of the
are earths are summarized. Phase relationships in the
ystems Gd–Fe, Gd–Ni, and Gd–Co were determined and
he existence of a large number of intermetallic compounds
erified. Parameters for Gd systems with Sb, Bi, B, Mn,
, Se, and Si are also given. These intermetallic com-
ounds were, in general, prepared by non-consumable melt-
ng of the component materials. Methods used to determine
nelting points are described. Oxidation resistance was de-
ermined by an atmospheric corrosion method. A number
f compositions in the Dy–Si and Hf–Si systems were pre-
ared and tested for corrosion resistance. (M.C.G.)

16052 (NP-9926) ELECTRON TRANSPORT IN A
SEMICONDUCTOR. H. L. Frisch (Bell Telephone Labs.,
Murray Hill, N. J.) and J. L. Lebowitz (Yeshiva Univ.,
New York). [nd]. 34p.
The linear transport properties of electrons were investi-
gated in a solid when both phonon and impurity scattering are
important. The problem is treated for the case where Max-
wellian statistics apply and the electrons are described by a
classical distribution function in position and velocity, $f(\underline{r},\underline{v})$
satisfying a space dependent equation in which the phonon
scattering only is described by a linear Boltzmann type
collision term. The equation is solved formally in the pres-
ence of a weak external electric field in a form convenient
for perturbation expansions in the relative strength of the
different scattering mechanisms. When the kernel describing
collision with phonons is "randomizing," it is shown that
the change in mobility caused by the presence of impurities
is always negative. (auth)

16053 (NP-9943) STUDY OF COMBINATIONS OF
HIGH AND LOW ELASTIC MODULUS CERAMIC MATE-
RIALS. Quarterly Report No. 4, December 15, 1960–
March 15, 1961. Peter T. B. Shaffer and Dick P. H.
Hasselman (Carborundum Co. Research and Development
Div., Niagara Falls, N. Y.). Mar. 17, 1961. Contract AF33
(616)-6806. 19p.
Physical property values were obtained on composite
bodies of zirconium carbide-graphite. Relative impact re-
sistance of the bodies was obtained. Thermal shock tests
were carried out to correlate the strength and Young's
modulus data with the relative increase in thermal shock
resistance on additions of the low elastic modulus dis-
persed phase. Limited tests on the refractory system
alumina-zirconia showed that when a low E-phase (ZrO_2)
was added to the high E-phase (Al_2O_3), the effect on strength
and Young's modulus was similar to that found in the zirco-
nium carbide-graphite system. (auth)

16054 (NP-9954) INTERNAL ROTATION OF Cis 2,3-
EPOXYBUTANE FROM THE MICROWAVE SPECTRUM
(thesis). Martin L. Sage (Harvard Univ., Cambridge, Mass.
Mallinckrodt Chemical Lab.). Feb. 1960. 26p.
The microwave spectrum of cis 2,3-epoxybutane was in-
vestigated from 8,000 to 29,000 Mc. The spectrum consists
of singlets and triplets. The ground torsional state shows a
pseudorigid rotor spectrum with rotational constants
8057.71, 4461.36, and 3468.60 Mc. The triplets yield a bar-
rier to internal rotation of 1607 ± 150 cal/mole independent
of assumptions concerning the coupling of the two methyl
groups. The dipole moment was found to be 2.03 ± 0.02D,
with 2.01 ± 0.02 D in the plane of the ring. A group theoret-
ical discussion of double rotors with one rotor on each side
of a plane of symmetry is given. (auth)

16055 (NP-9963) CRYSTAL PHYSICS. Final Sum-
mary Report, November 15, 1959–January 1, 1961. Tech-
nical Report No. 159. (Massachusetts Inst. of Tech.,
Cambridge. Lab. for Insulation Research). Feb. 1961.
Contract Nonr-1841(50). 23p.
A variety of organic, inorganic, and metal crystals was
grown for the study of properties and special effects. The
cooling and evaporation methods were used for crystal
growing from solution. Special temperature-control units
were built with a precision of ±0.002°C. For crystals with
additives grown under vacuum, a special method was de-
veloped to reduce the evaporation of the component with
higher vapor pressure. Of particular interest were mixed
crystals grown by flame fusion. Imperfections of crystals
were studied by high-precision lattice-constant determina-
tion, weighing density, thermal etching, ionic conductivity,
and optical absorption. A great part of the work was de-
voted to a study of electron and hole traps in pure and

doped crystals by color centers. The crystals were colored by x rays, high-energy electrons, or additively at various temperatures. The optical measurements were extended from 3 microns to 1750A. A study of optical anisotropy of trapping centers, using polarized light and anisotropic crystals, was initiated. (auth)

16056 (NP-9971) STUDY OF COMBINATIONS OF HIGH AND LOW ELASTIC MODULUS CERAMIC MATERIALS. Quarterly Report No. 3, April 15, 1960–July 15, 1960. Peter T. B. Shaffer, Dick P. H. Hasselman, and Aleksander Z. Chaberski (Carborundum Co. Research and Development Div., Niagara Falls, N. Y.). July 28, 1960. Contract AF33(616)-6806. 21p.

Physical properties such as elastic modulus, shear modulus, Poisson's ratio, rupture modulus, and thermal expansion coefficients were determined for hot-pressed ZrC, graphite, and graphite-ZrC systems. The results indicate that the observed increase in thermal shock resistance of carbide-graphite systems is caused by an increase in the strength to modulus of elasticity ratio with increasing graphite content. Spherical shapes of the carbide and composite bodies were fabricated for determining the relative thermal shock resistance for comparison with calculated values. (B.O.G.)

16057 (NP-9972) STUDY OF COMBINATIONS OF HIGH AND LOW ELASTIC MODULUS CERAMIC MATERIALS. Quarterly Report No. 2, January 15, 1960–April 15, 1960. Peter T. B. Shaffer, Dick P. H. Hasselman, and Alexander Z. Chaberski (Carborundum Co. Research and Development Div., Niagara Falls, N. Y.). May 10, 1960. Contract AF33(616)-6806. 14p.

Preliminary experiments to measure the modulus of elasticity as a function of temperature and composition by a sonic method indicate that accurate, consistent results can be obtained. The value determined for ZrC was 48.8×10^6 psi. Modulus of rupture measurements was made for graphite and ZrC at 25 and 2000°C. (B.O.G.)

16058 (NP-9977) REPEATED TENSILE LOADING OF IRON AND STEEL. Technical Report No. 5. C. P. Sullivan, B. L. Averbach, and Morris Cohen (Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy). Mar. 24, 1961. Contract Nonr-1841(35). 27p. (DSR-7618).

Single crystals, bicrystals, and polycrystalline α ferrite, as well as hardened AISI 4340 steel in several tempered conditions, were subjected to repeated tension/release cycles. The elastic modulus, the 10^{-6} yield stress, and static stress-strain hysteresis loops were measured at various stages during the fatigue program. In addition, a surface replication method was employed for studying prepolished surfaces of the test specimens to detect the initiation and growth of fatigue microcracks. It appeared that fatigue processes occur in polycrystalline iron under pulsating tension. This was evidenced by the presence of fatigue slip bands and microcracks. Fatigue microcracks were not found in either the single crystals or bicrystals of ferrite, although the presence of certain metallographic features indicated that a limited type of fatigue process may occur. Both the elastic modulus and 10^{-6} yield stress of strain-aged iron specimens decreased after subsequent plastic deformation whether the latter is imposed statically or by a relatively few pull/release cycles. Further cycling caused an increase in both properties. The curvature of the unloading line in static stress-strain hysteresis loops at relatively low stresses indicated that a limited amount of reversible plastic flow occurs in tensile straining. (auth)

16059 (NP-10001) THE TENSILE, NOTCHED TENSILE AND TENSILE IMPACT PROPERTIES OF CROSS-ROLLED -100 MESH QMV BERYLLIUM SHEET. Progr Report No. 1. (Curtiss-Wright Corp. Wright Aeronauti Div., Wood-Ridge, N. J.). Sept. 13, 1960. 102p. (D-848

The notched strength-to-unnotched strength ratio in sl tension was larger than one at all test temperatures. Thi indicates that beryllium is not notch sensitive to a theore cal concentration factor of four ($K_t = 4$) at the strain rate used. The results of the tensile and tensile-impact tests suggest that there is a definite relation between ductility, repeated yielding, and the change in fracture mode. Unlik in the case of many metals ductility does not always increase with decreasing strain rate. A brittle-to-ductile transition range in static tension exists between 0 to 200° The range was found to occur in the impact tests at 0 to 575°F and 175 to 440°F for the transverse and longitudinal directions, respectively. A 1.8×10^6 fold increase in tens test velocity broadened the transition range and displaced it upward by approx 500°F. Twinning is the probable prim mode of deformation below the transition temperature. Twinning probably precedes crack nucleation and propaga tion in the brittle range, and yielding in and above the transition range. It is believed that twinning influences fracture by determining the extent of local slip at the ends of the twins and/or by acting as barriers to dislocations attempting to move from the high stress areas. A change occurred in fracture mode (intercrystalline to trans-crystalline) in static tension at 500° to 1100°F. The equicohesi temperature was found to be 775°F and 1250°F in static ten sion and tensile impact, respectively. (auth)

16060 (NP-10005) COMPATIBILITY OF MATERIALS WITH HIGH TEMPERATURE POTASSIUM. Second Quarterly Progress Report, August 1 through October 31, 1960. (Rocketdyne Div., North American Aviation, Inc., Canoga Park, Calif.). Nov. 30, 1960. Contract NAS 5-453. 31p. (R-2617-2)

Refractory metals were evaluated for potential use in high-temperature, turboelectric, space powerplants using potassium as the working fluid. In isothermal-capsule tests to 2000°F, corrosion of wrought niobium and niobium–1% zirconium alloy was negligible except when the metals were combined with nickel alloys. In 50 hr of Rankine-loop tests to 1800°F, molybdenum resisted attack best of the refractor metals tested. Limited mechanical properties tests are described. Two niobium alloy loops are under construction, and the first vacuum chamber is complete. (auth)

16061 (NP-10013) NONDESTRUCTIVE ANALYSIS OF THE BRITTLE FRACTURE BEHAVIOR OF CERAMIC MATERIALS. Quarterly Progress Report No. 2, December 1, 1960 to February 28, 1961. Joseph L. Pentecost and Julian H. Lauchner (Mississippi State Univ., State College). Feb. 1961. Contract AF33(616)-7347. 31p.

A technique for calculating maximum stress in an elastic loop is presented and was applied to the measurement of the strength of glass fibers from three to seven mils in diameter. The strength values were related to surface condition by surface decoration techniques. Surface flaw decoration of cleaned and polished surfaces was performed by condensation of water on the surface. Minute flaws estimate to be less than 1000A deep were revealed. Applications for surface decoration techniques and internal stress were outlined. Effort was directed toward relating brittle failure mechanisms to some surface or volume parameter suitable for quantitative, nondestructive measurement. (auth)

16062 (NP-10016) STUDY OF LOW TEMPERATURE MECHANICAL PROPERTIES OF METALS AND SOLIDIFIED GASES. Final Technical Report, January 22, 1957–January 21, 1961. J. W. Beams and J. W. Stewart (Virginia.

, Charlottesville). Mar. 1, 1961. Contract DA-36-ORD-2219. 21p. (OOR-826:10-16).

udies of Metals at Low Temperature. Two methods for mining the tensile strength of thin metallic films are ied, and results are presented for silver and gold films. Films of thickness greater than 2×10^{-5} cm, the tensile gth was of the same order as that of the bulk material, eas for thicknesses $\leq 10^{-5}$ cm, the tensile strength in- ses markedly as the thickness is reduced. Gold films ared by slow evaporation (<10 A/min) in vacuum were l to have tensile strengths not far above the bulk gth even for thicknesses less than 10^{-5} cm. However, the evaporation is increased to ~1000 A/min, films than 1.5×10^{-5} cm thick show marked increases in gth. It is concluded from microscopic examination the high strength of thin films must partially be due to ng of dislocations in the metal. Adhesion of thin films her metals is discussed. The tensile strengths of gases measured at low temperatures and found to be −0.6 for helium II, −12 atm for argon, −10 atm for nitrogen, −15 atm for oxygen. Studies of Solidified Gases at Low perature. A bibliography is given for work done on sure-volume-temperature relations for various solidi- gases. Some new work is reported: silane and HCl show transitions at high pressure, while the expected sition in HBr did not appear. (D.L.C.)

3 (OOR-1920:2) SEMICONDUCTOR RESEARCH H THE ELECTRON PROBE X-RAY MICROANALYZER. AL REPORT ON METALLURGICAL APPLICATIONS THE ELECTRONMICROPROBE. David B. Wittry ifornia Inst. of Tech., Pasadena). Jan. 1961. Con- t DA-04-495-1655. 19p.

ne electron probe microanalyzer was used for a study ne As-Ga-Ge system. The solubility of germanium in ium arsenide was found to be about 1 ± 0.02% at 980°C increases with decreasing temperature of values of it 2.5 to 3% at 850°C. The diffusivity of germanium in ium arsenide is low. The present investigation does indicate a change in diffusion constant with concentra- for germanium in gallium arsenide. In the germanium- part of the As-Ga-Ge ternary diagram, the solubili- may exceed the solubilities in the binary systems by ctor of 5 to 10. (auth)

64 (ORNL-3088) MEASUREMENT OF DISSOCIA- ON PRESSURE OF MOLYBDENUM FLUORIDE–SODIUM UORIDE COMPLEX. F. R. Groves, Jr. (Oak Ridge Na- al Lab., Tenn.). Apr. 11, 1961. Contract W-7405-eng- 19p.

he dynamic (gas saturation) method was used to deter- ne upper and lower limits for the dissociation pressure he complex formed when MoF_6 is absorbed by NaF. e limits were 0.4 to 4.6 mm Hg at 100°C and 8.4 to 27 Hg at 150°C. A lower limit, 64 mm Hg, was determined 200°C. As a check on the method the dissociation pres- e of the complex $UF_6 \cdot (NaF)_3$ was determined at 100,), and 240°C. The measured values were in satisfactory eement with accepted values of dissociation pressure this compound. (auth)

065 (SB-451) LOW TEMPERATURE RESEARCH ON ATERIALS. OTS Selective Bibliography. (Office of chnical Services. Washington, D. C.). Feb. 1961. 28p. A bibliography of reports listed in OTS monthly abstract rnals U. S. Government Research Reports and Technical anslations is presented. (About 300 references.) (J.R.D.)

066 (TID-11915) ENHANCED NON-EQUILIBRIUM FFUSION IN PLASTICALLY DEFORMED AgZn. C. H. Neuman, D. Lazarus, and D. B. Fitchen (Illinois. Univ., Urbana). [1960]. 14p.

Deformation enhanced diffusion studies in AgZn alloys were made by following the rate of anelastic relaxation as a function of time immediately following a very small plastic strain. The results were compared with results obtained from quenched specimens. Typical relaxation curves are included for deformed and quenched specimens, together with a relaxation curve for a well-annealed specimen extrapolated to the measuring temperature of 59°C. The shapes of the relaxation curve are seen to be essentially the same, except for a shift in the time scale, implying that the same diffusion-limited process is operative in all cases. This conclusion is attested by the fact that the total anelastic relaxation is identical for deformed, quenched, and equilibrated specimens. (B.O.G.)

16067 (TID-12350) DIFFUSION OF RADON THROUGH SEMI-PERMEABLE MATERIALS. Technical Progress Report. Elmer Nussbaum (Taylor Univ., Upland, Ind.). Mar. 1961. Contract AT(11-1)-649. 23p.

Experiments were conducted to investigate the rate at which radon is diffused through rubber vulcanates. A program was also begun to study the rate of transmission of tritium through similar materials. The sheet of semi-permeable material was interposed between two glass vessels. Dry nitrogen or room air was admitted into one vessel and radon in air was admitted simultaneously to the other. The rate at which radon was transmitted through the semi-permeable material was evaluated by measuring the changes in radon concentration in each vessel as a function of time. The rate of transmission through Butaprene NL was approximately 5% per 110 hr, as compared with Butaprene T which permitted the transmission of 30% of the radon in 110 hr. The transmission rate of radon through Silicone Rubber #371 was approximately 30% in 9 hr and 30% was transmitted through Silicone Rubber #450 in approximately 5 hr. The diffusion rate was lower at 0°C than at 25°C. The apparatus was used in the same manner for tritium studies. About 30% of the tritium diffused through Silicone Rubber #371 in 70 hr, as compared with 30% in 45 hrs for Silicone Rubber SE-751. The rate of diffusion of tritium through silicone rubber was directly related to temperature. It was found that the diffusion of radon through silicone rubbers proceeds at a rate 6 to 8 times as fast as the diffusion of tritium through the same material. (M.C.G.)

16068 (TID-12488) THE HEATS OF COMBUSTION OF NIOBIUM CARBIDES. Elmer J. Huber, Jr., Earl L. Head, Charles E. Holley, Jr., E. K. Storms, and N. H. Krikorian (Los Alamos Scientific Lab., N. Mex.). [1960]. 15p.

A series of niobium carbides, NbC_x, was burned in an oxygen bomb calorimeter. The carbides covered a range from x = 0.489 to x = 0.984. Extrapolation of the curve, $\Delta H = 6.06 - 70.95x + 30.75x^2$, obtained for eight compositions ($NbC_{0.888}$ through $NbC_{0.984}$) to x = 1 gave −33.6 ± 0.6 kcal/mole as the heat of formation of NbC. The heat of formation of Nb_2C was −46.6 ± 1.2 kcal/mole. Combustion of powdered Nb metal gave a heat of formation of −454.4 ± 1.6 kcal/mole for Nb_2O_5. A comparison of these values with those of other workers is made. (auth)

16069 (WADD-TR-60-74(Pt.II)) THE METALLURGY OF YTTRIUM AND RARE EARTH METALS. PART II. MECHANICAL PROPERTIES. Period covered: October 1958 to October 1959. Bernard Love (Nuclear Corp. of America. Research Chemicals Div., Burbank, Calif.). Feb. 27, 1960. Contract AF33(616)-5905. 64p. (AD-243598)

Study of the mechanical properties of rare earth metals was continued. Tensile, compression, fatigue, and impact properties were determined. Evaluation of the metals was extended to include hot and cold working characteristics, and studies were made of alloy systems predicted to have improved mechanical properties. Cast yttrium, dysprosium, and erbium were cold worked to improve mechanical properties. All were easily swaged at 980°C (1800°F). The resulting structures were uniform and dense, and the properties were improved over the cast condition. Tensile properties were quite comparable when the metals were in the same condition. Ductility (as measured by reduction of area) was somewhat limited for the cast structures, but was improved by working. The cast rare earth metals were notch sensitive. The fatigue properties followed the normal pattern of increased life with decreased maximum applied load. Extrapolated S-N curves indicated fatigue endurance limits in the order of 40 to 50% of the corresponding ultimate tensile strengths. Zirconium entered into solid solution in erbium and resulted in marked tensile strengthening. Dispersed, second phase zirconium, also contributed to hardening. The recrystallization behavior of erbium and yttrium follows a normal sequence of recovery, recrystallization and grain growth. Complete recrystallization of erbium, cold worked 60%, occurred at approximately 1100°C; yttrium at approximately 900°C. Studies were made of several methods for improving the purity of rare earth metals. Carbon deoxidation decreased the oxygen content slightly. Attempts to purify yttrium, erbium, and dysprosium by electron beam melting were not successful. Small quantities of both dysprosium and scandium were, however, successfully vacuum distilled at elevated temperatures. Analytic results indicated that the distilled metals are of significantly higher purity. (auth)

16070 (WADD-TR-60-304) THE INFLUENCE OF HIGH PRESSURES AND HIGH TEMPERATURES ON TRANSFORMATIONS AND COORDINATION IN CRYSTALLINE AND VITREOUS CERAMIC MATERIALS. W. F. Claussen, R. C. DeVries, and J. D. MacKenzie (General Electric Co. Research Lab., Schenectady, N. Y.). May 2, 1960. Contract AF33(616)-6295. 40p.

The effect of high pressures and temperatures on densification of vitreous silica and germania and on the polymorphism of crystalline Al_2SiO_5 was investigated using the high-pressure techniques developed for diamond synthesis. Germania glass of a density approximately equivalent to that of the quartz-form germania was made by this technique. A shift of IR reflection bands at 1110 cm^{-1} for SiO_2 and 895 cm^{-1} for GeO_2 suggested that the densification of the glasses is a result of the decrease of the M-O-M angle, but the over-all spectra for both compressed vitreous SiO_2 and GeO_2 are unchanged from the correspondingly less dense glasses. High temperatures and pressures study of the system Al_2SiO_5 established that high-pressure form kyanite melts to α-Al_2O_3 plus liquid. When kyanite is "hot-pressed" in its stability region, the grains show complex slip and kink pattern; but kyanite found under the same conditions from andalusite or sillimanite have simple grains possibly from twinning. No region of liquid immiscibility was found in the system as might be expected. (auth)

16071 (WADD-TR-60-426) FATIGUE AND STRESS RUPTURE PROPERTIES OF INCONEL 713C, V-57C AND TITANIUM ALLOY 7Al-3Mo-Ti AND MST 821 (8Al-2Cb-1Ta-Ti). Period covered: January 1958 to December 1959. A. E. Cers and A. A. Blatherwick (Minnesota. Univ., Minneapolis). June 6, 1960. Contract AF33(616)-6828. 80p. (AD-243934)

Fatigue, rupture and creep data at various temperatures obtained at various alternating and mean stress combinations are presented for the alloys Inconel 713C, V-57C (modified Super A-286), 7Al-3Mo-Ti and MST 821 (8Al-2Cb-1Ta-Ti). The tests were performed on unnotched specimens and for Inconel 713C also on notched specimens having a theoretical stress concentration factor of 2.9. The data are presented as S-N curves and stress-range diagrams to show the effect of temperature, ratio of alternating-to-mean stress, stress magnitude and specimen notch on the fatigue and rupture properties. (auth)

16072 (WADD-TR-60-721) EFFECTS OF SPACE ENVIRONMENT ON MATERIALS. J. H. Atkins, R. L. Bisplinghoff, J. L. Ham, E. G. Jackson, and J. C. Simons, Jr (National Research Corp., Cambridge, Mass.). Aug. 1960. Contract AF33(616)-6288. 67p.

A general survey is presented of the current knowledge on the effects of space environment on materials. The status of the following fields is discussed in detail: nature of space radiation, mechanical properties in vacuum, friction and bearings in vacuum, surface electric properties in vacuum, and meteoroid collisions. The problem of simulating the space environment in the laboratory is discussed. (D.L.C.)

16073 (WAL-TR-834.2/2) STRAIN HARDENING PROPERTIES OF HIGH-STRENGTH SHEET MATERIALS. Frank R. Larson and John Nunes (Watertown Arsenal Lab., Mass.). Mar. 1961. 43p. (PB-171561)

Materials studied were H-11 die steel, Cr-Mo tool steel, AMS 5548, AMS 5547, ¾ hard 301 stainless steel, and some alloyed and unalloyed titanium. Effects of heat treatment and low testing temperature on flow stress, fracture stress, fracture strain, and strain hardening were evaluated. A study on mechanical anisotropy and true strain rate was conducted. (auth)

16074 (CEA-tr-R-545) THEORIES MODERNES SUR LA STRUCTURE DU CHARBON. (Modern Theories on the Structure of Carbon). R. N. Smirnov. Translated into French from Uspekhi Khim., 28: 826-49(1959). 63p.

A bibliographic study is made of the modern theories and hypotheses on the structure and properties of carbon. 113 references. (J.S.R.)

16075 (NP-tr-570) THEORY OF DIFFUSION IN ORDERING ALLOYS. M. A. Krivoglaz and A. A. Smirnov. Translated from p.203-56 of "Teoriya Uporyadochivayushchikhsya Splavov" (A Publication of the State Publishing House of Literature on Physics and Mathematics, Moscow, 1958). 76p.

In order to explain the process of diffusion which takes place in solid bodies, three basic mechanisms of the migration of atoms in a crystal lattice were proposed. One, however, the interchange of atom sites, could not explain the phenomenon of the electric conductivity of ionic crystals. Two types of theories on diffusion in metals and alloys prevail: phenomenological and microscopic. The phenomenological theory of diffusion attempts to obtain generalized macroscopic equations for the determination of the flux of diffusing substances, to establish a relationship between the chemical-diffusion and self-diffusion coefficients, and to provide an explanation of the Kirkendall effect of the phenomenon of rising diffusion. In the microscopic theory of diffusion the calculations are made within the framework of a specific atomic model of the crystal. Fundamentals of the phenomenological theory of diffusion in alloys, the theory of diffusion of interstitial atoms through the interstices, equilibrium concentration of the vacancies on lattice sites of

oys, and self-diffusion in alloys through the vacancy chanism are discussed. (M.C.G.)

076 (NP-tr-581) FAILURE OF METALS IN CONCT WITH LIQUID METAL. G. V. Karpenko. Translated m Priklad. Mekh., 3: No. 1, 13-19(1957). 12p.

A study was made of the influence of mercury on the ability of polished and rolled specimens of brass and alumin to cyclic stresses at room temperature. The ability of untreated brass specimens was greater than ated specimens tested in air and mercury, except for lled specimens tested in air. The durability of the unated duralumin was greater for polished specimens sted in air and rolled specimens tested in mercury, ile the durability was greater for treated polished specens tested in mercury and treated rolled specimens sted in air. Results do not confirm the diffusion hypothis of the mechanism of failure of stressed metal under e action of liquid metal. (B.O.G.)

077 (NP-tr-584) X-RAY DIFFRACTION STUDY OF HE STRUCTURE OF FERROMAGNETIC ALLOYS Fe–Mo ND Fe–Mo–Co. Ya. Pines and I. N. Barutkin. Translted from Fiz. Metal. i Metalloved., 6: 832-7(1958). 12p.

Harmonic analysis of the form of x-ray diffraction lines as used to determine the magnitude of microstresses and ramagnetic inclusions in the alloys Fe–Mo and Co–Fe–o after different thermal treatments. Structural characristics were compared with magnetic properties. The eason for the variation in the coercive force was also dermined. Results indicated that during tempering, the icrostresses in the Fe–Mo alloy arise as a result of the eparation from solution of the paramagnetic phase Fe_3Mo_2. he initial growth appeared to be governed by a quantitave increase in the separating phase while the decrease as governed by a reverse solution of the θ phase of e_3Mo_2. The microstresses in the Fe–Mo–Co alloy were lso caused by the separation of the paramagnetic phase rom the solution during tempering. It was found that the oercive force is basically determined by the microtresses and by the finely dispersed inclusions. No noiceable dependence of this force on the volumetric conentration of the paramagnetic inclusions was observed. M.C.G.)

16078 (NP-tr-590) PROBLEMS OF PHYSICS OF METALS AND METALLOGRAPHY. Translation of Selected Articles from Voprosy Fiziki Metallov i Metallovedeniya, Akademiya Nauk Ukrainskoi S.S.R., Sbornik Nauchnykh Rabot, No. 9. 1959. 78p.

A translation is presented of 5 articles on the physics of metals. Separate abstracts have been prepared for each article. (M.C.G.)

16079 (NP-tr-590(p.1-15)) THE EFFECT OF VARIOUS METHODS OF DEFORMATION ON THE CRYSTAL STRUCTURE OF NIOBIUM. L. I. Lysak and L. V. Tikhonov. Translated from Voprosy Fiz. Metal. i Metalloved., Akad. Nauk Ukrain. S.S.R., Sbornik Nauch. Rabot, No. 9, 27-35 (1959).

The effects of varying degrees of different types of cold-work on the space lattice strains of the second and the third kind, the size of the coherence region, the texture, and the strength characteristics in niobium were investigated. The hardness of niobium strengthened by uniaxial static compression increased until the compression reached approximately 25%. When the degree of deformation increased from 25 to 55 or 60%, the hardness increased insignificantly. With further compression, the hardness of the specimens continued to increase at a more rapid rate. The true compressive stress changed with the degree of deformation in much the same way that hardness did. Until deformation reached 60 to 70%, the curve for the lattice strain of the second kind remained similar to those for hardness and for the true compressive stress. However, when deformation exceeded 60%, the increase in lattice strain became insignificant. Lattice strains of the third kind increased rapidly until deformation reached about 7% and then remained practically unchanged until the deformation reached 60%. At deformations of 4 to 35%, strengthening apparently resulted from increased utilization of the atomic bonds due to the increased number of defects in the lattice, resulting mainly from strains of the second kind. The increased strengthening at higher deformations appeared to be due to a perfection of texture and a greater lack of easiest slip planes advantageously oriented with respect to the acting force. (M.C.G.)

16080 (NP-tr-590(p.16-27)) EFFECT OF HEAT TREATMENT ON THE MECHANICAL PROPERTIES OF Ti–Fe ALLOYS. V. N. Gridnev, V. I. Trefilov, and A. S. Drachinskii (Drachinskiy). Translated from Voprosy Fiz. Metal. i Metalloved., Akad. Nauk Ukrain. S.S.R., Sbornik Nauch. Rabot, No. 9, 82-8(1959).

A study was made of the effects of various tempering procedures on the mechanical properties of low-alloy Ti–Fe alloys as well as with the basic structural and phase changes due to a particular combination of mechanical characteristics. Ti–Fe alloys obtained by the powder metallurgy method from titanium reduced with calcium hydride were used. High strength and low plasticity characteristics were obtained by tempering at 400 to 500°C. During aging above 500°C, a relatively small drop in strength and a sharp increase in plasticity was observed regardless of the duration of the aging. The resistance of the alloys to brittle fracture increased with tempering temperature. Results indicated that a hardness maximum is reached in specimens held at 400°C for 5 hr. (M.C.G.)

16081 (NP-tr-590(p.28-43)) STRUCTURAL AND PROPERTY CHANGES IN POWDER METALLURGY TITANIUM DURING ROLLING IN A VACUUM. A. K. Butylenko, V. N. Gridnev, and V. I. Trefilov. Translated from Voprosy Fiz. Metal. i Metalloved., Akad. Nauk Ukrain. S. S. R., Sbornik Nauch, Rabot No. 9, 89-97(1959).

The hot deformation of titanium in high vacuum was investigated. After various deformation procedures and vacuum exposures, titanium specimens were subjected to open cooling in the vacuum chamber and subsequently to microstructural and x-ray structural analyses and mechanical tests at room temperature. After short vacuum exposures, the mechanical properties remained practically the same. When exposure was increased to 4 hr, a small increase in the reduction in cross-sectional area was observed, but the strength and elongation remained almost the same. After an 8 hr exposure, some increase in strength and a noticeable drop in plasticity took place. This drop in plasticity was found to be due to structural changes rather than vacuum exposure. With an increasing degree of deformation, a noticeable rise in the yield point and the tensile strength took place. Rolling at temperatures of the order of 1000°C yielded the most advantageous combination of strength and plasticity characteristics. During hot plastic deformation, a breaking down of grains was found to occur, and, under certain conditions, a relatively fine-grained structure was obtained. (M.C.G.)

16082 (NP-tr-590(p.44-67)) A STUDY OF THE SYSTEM Cr–Nb–V. V. N. Svechnikov, Yu. A. Kocher-

zhinskii (Kocherzhinskiy), E. E. (Ye. Ye.) Maystrenko, V. M. Pan, and A. K. Shurin. Translated from Voprosy Fiz. Metal. i Metalloved., Akad. Nauk Ukrain. S. S. R., Sbornik Nauch. Rabot, No. 9, 120-32(1959).

An investigation was made of the Cr–V, Nb–V, Cr–Nb, and Cr–Nb–V systems. The microstructure of an alloy with 48.8% Nb and 10.8% V was determined after heating in a vacuum at 1000°C. This alloy contained only one phase, which was apparently a solid solution of vanadium in the intermetallic compound $NbCr_2$. There were no ternary chemical compounds found in the Cr–Nb–V system. The quasi binary section V–$NbCr_2$ was a binary diagram of the eutectic type. The boundaries of the phase regions were determined. The study of the microstructure of cast Cr–Nb alloys corroborated literature data by showing that over 2% Nb by weight is soluble in Cr and that the eutectic is reached at about 30% Nb. It was concluded from several tests that, in Cr-base alloys, Nb increases the hardness sharply at room temperature, but is of little use for retention of high strength after heating. (M.C.G.)

16083 (NP-tr-590(p.68-78)) INFLUENCE OF ALLOYING AND HEAT TREATMENT ON ELASTIC PROPERTIES OF NICKEL ALLOYS. I. G. Polotskii (Polotskiy) and T. Ya. Beni'eva (Beniyeva). Translated from Voprosy Fiz. Metal. i Metalloved., Akad. Nauk Ukrain. S. S. R., Sbornik Nauch. Rabot, No. 9, 178-84(1959).

A study was made of the concentration and temperature dependence of the modulus of elasticity of Ni–Cr and Ni–Ti alloys. The effects of heat treatment on the elastic properties were also studied. The modulus of elasticity of Ni–Cr and Ni–Ti alloys increased with increasing Cr concentration from 10.48 to 23.46 atomic %. By adding Ti in small concentrations, the modulus did not significantly increase, but with the increase in Ti concentration, the modulus of elasticity decreased. The values for Young's modulus decreased with increasing temperature. Young's modulus increased in the alloys after annealing at a temperature of 400°C. The modulus of elasticity had a maximum value at 450°C. (M.C.G.)

16084 (NP-tr-591) INCREASING THE LEVEL OF PROPERTIES OF CHROMIUM–MANGANESE–SILICON STEEL BY ADDITIONAL ALLOYING. M. P. Braun. Translated from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, No. 5, 119-22(1955). 6p.

The possibility of changing the tenacity and temperability of Cr-Mn-Si steel by the addition of other elements was investigated. The following elements were used as alloying additions: W, Ti, Nb, V, B, Ni, or a Ti + W + Ni mixture. Some of the changes in properties brought about by these additions include strengthening of the crystal lattice, increasing the tenacity and plastic properties of steel, making martensite more annealing-resistant, reducing the tendency toward tempering brittleness and brittle destruction, and improving the hardenability. (M.C.G.)

16085 (NP-tr-592) RECRYSTALLIZATION PROCESSES IN NICKEL ALLOYS. M. E. Blanter and L. I. Kuznetsov. Translated from Metalloved. i Obrabotka Metal., No. 12, 31-6(1957). 12p.

The effects of Mo, Cr, Ti, and Co on the softening, recovery, and recrystallization processes in nickel alloys were investigated. The effect of the degree of prior deformation was also studied. A comparison of results from investigations of softening and microstructure showed that in all cases softening began at a lower temperature than the recrystallization threshold of the specimen. It was concluded that the initial stage of softening is due to the recovery process. The recrystallization range of the specimen steadily decreased with an increase in the degree of plastic deformation and usually was in a range of 100°C. The effect of heating temperature on the value of the specific grain-boundary area was investigated for a series of Ni–Mo alloys subjected to similar prior plastic deformation equal to 38%. An increase in Mo content increased the initial and final softening temperatures and the initial temperature of recrystallization processes. An addition of cobalt to nickel caused the appearance of a wide temperature range of recovery. When Co, Ti, or Mo were introduced, the final softening occurred in the process of spontaneous recrystallization. (M.C.G.)

16086 THE STRUCTURE OF THE σ-PHASE Nb_2Al. P. J. Brown and J. B. Forsyth (Cavendish Lab., Cambridge Eng.). Acta Cryst., 14: 362-4(Apr. 10, 1961). (In English)

The σ-phase structure of Nb_2Al is confirmed by single-crystal measurements. The distribution of atoms in the available sites are determined and the atomic parameters are refined. The relationship of this structure to other σ-phases is discussed. (auth)

16087 APPLICATION OF MICROSCOPIC METHODS TO THE STUDY OF THE REACTION BETWEEN URANIUM CARBIDE AND ZIRCONIUM METAL. A. Accary and J. Trouve (Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay, France). Bull. soc. chim. France, No. 1, 26-30(Jan. 1961). (In French)

It is known that zirconium carbide is more stable than uranium carbide. Thermodynamically uranium monocarbide UC and Zr ought to react according to the scheme UC + Zr → ZrC + U. A study was made to define the kinetics of this reaction when it occurs in the solid state. Zirconium was welded with uranium monocarbide and the samples formed were heated for various times at different temperatures. The zone next to the weld was then studied by micrographic techniques. A metallic uranium matrix was found in the primitive carbide. There was formation of an "intermediate zone" phase constituted of a mixed carbide of uranium and zirconium and whose composition varies progressively from one end to the other of this zone. The kinetics are controlled by a diffusion phenomenon which is approximately that of the carbon in the zirconium carbide formed. (tr-auth)

16088 THE EQUILIBRIUM DIAGRAMS OF THE SYSTEMS ZIRCONIUM OXIDE–RARE EARTH OXIDES. Robert Collongues, Monique Perez y Jorba, and Jean Lefèvre (C.N.R.S., Paris). Bull. soc. chim. France, No. 1, 70-4 (Jan. 1961). (In French)

The equilibrium diagrams of ZrO_2–M_2O_3 (M = Y, La, Nd, Sm, Gd, Dy, and Yb) were studied by various techniques, particularly radiocrystallographic analysis and dilatometry. The primary solid solutions containing from 1 to 10 mol % of the rare earth oxide were prepared by the coprecipitation method in the amorphous state. A quadratic phase with a deformed fluorine type structure and a cubic phase with fluorine structure were detected. The only intermediate phase present was one of the pyrochlore type with composition near $M_2Zr_2O_7$. The equilibrium diagrams showed a considerable range of solid solutions showing the quadratic-cubic transition for the systems ZrO_2–Yb_2O_3 and ZrO_2–Gd_2O_3. A progressive augmentation of the extent of the biphase region and of the stability of the pyrochlore phase was noticed when the ion radius of the rare earth increases. (J.S.R.)

16089 THE EQUILIBRIUM DIAGRAMS OF THE SYSTEMS FORMED BY GERMANIUM OXIDE WITH THE

OXIDES OF ZIRCONIUM AND HAFNIUM. Jean Lefèvre and Robert Collongues (C.N.R.S., Paris). Bull. soc. chim. France, No. 1, 74-7(Jan. 1961). (In French)

Solid solutions GeO_2-AO_2 (A = Zr or Hf) were prepared by the coprecipitation method. Radiocrystallographic analysis permitted the identification of the phases present after thermal treatment between 50 and 1600°C. Two compounds were distinguished in each system: $AGeO_4$ and A_3GeO_8. The $AGeO_4$ compounds have the Scheelite $CaWO_4$ structure with a face-centered lattice. A comparison of the Debye-Scherrer diagrams of $HfGeO_4$ and Hf_3GeO_8 show supplementary rays in the latter compound. The intensity of the rays correspond to that calculated. The diagram of Zr_3GeO_8 shows no supplementary rays with respect to that of $ZrGeO_4$. An extended region of homogeneity which is temperature-independent from 1200 to 1600° is found at the stoichiometric composition. The equilibrium diagrams of the systems ZrO_2-GeO_2 and HfO_2-GeO_2 show three distinct monophase regions occupied by quadratic phases whose structures are simply derived from the structure of quadratic ZrO_2. (J.S.R.)

16090 REMARKS ON THE STABILIZATION OF CUBIC ZIRCONIA. Jochen Stocker (C.N.R.S., Paris). Bull. soc. chim. France, No. 1, 78-9(Jan. 1961). (In French)

The mechanism for the stabilization of zirconium oxide is defined. The mechanisms proposed by Ruff and Ebert and by Dietzel and Tober are first discussed, and their inadequacies are summarized. The oxides capable of stabilizing cubic ZrO_2 are those with the general formula MO_n ($n < 2$), and the cubic solid solutions formed, ZrO_2-MO_n, have a lacunal structure having lacunes in the anion lattice. The equilibrium diagram of these solid solutions has a eutectoid point, and the solid solution formed is also more stable when the temperature is low. The solid solution is very stable if the cation of the addition oxide is strongly electropositive. (J.S.R.)

16091 THE COMPOUNDS FORMED BY THORIA WITH THE OXIDES OF THE TETRAVALENT METALS. Monique Perez y Jorba, Hélène Mondange, and Robert Collongues (Centre National de la Recherche Scientifique, Paris.). Bull. soc. chim. France, No. 1, 79-81(Jan. 1961). (In French)

The compounds formed by ThO_2 with SiO_2, GeO_2, and TiO_2 were studied and their properties defined. The compound $ThSiO_4$ has a monoclinic structure probably derived from the structure of $ZrSiO_4$ by deformation of the cell. Dilatometric analysis reveals no transformation to the quadratic phase. The compound $ThGeO_4$ exists in two allotropic forms. One is of the scheelite type and is stable up to 1180°C. The other is of the zircon type and is stable above this temperature. The transformation is accompanied by a strong dilatometric anomaly. Thoria is weakly soluble in the scheelite type, but the zircon type appears rigorously stoichiometric. The compound $ThTi_2O_6$ has two allotropic varieties. The α variety is stable from room temperature up to 1300°C and its density is 6.2. The β variety is stable above 1300°C and has a density of 5.8. The transformation $\alpha \rightarrow \beta$ is accompanied by dilation. (J.S.R.)

16092 COMPOUNDS OF THE URANIUM–SELENIUM SYSTEM. PREPARATIONS. PHYSICAL AND CHEMICAL PROPERTIES. Parviz Khodadad (Faculté de Pharmacie, Paris). Bull. soc. chim. France, No. 1, 133-6(Jan. 1961). (In French)

Eight definite compounds of the U–Se system were prepared: USe_3, $USe_2\gamma$, $USe_2\alpha$, $USe_2\beta$, U_3Se_5, U_2Se_3, U_3Se_4, and USe. The uranium polyselenide USe_3 can be prepared by reaction of UCl_4 and Se in the presence of hydrogen, reaction of metallic uranium filings with H_2Se, and reaction of US_2 with H_2Se. The last reaction gives the purest yield. All the other selenides are prepared by successive elimination of the selenium by treatment under vacuum in a temperature range from 500 to 1500°C. A hydrogen current can also be used to eliminate the selenium. The crystallographic data and the densities of these compounds are tabulated. The chemical reactions with water, oxygen, sulfur, halogens, acids, alkali metals, and mercury are summarized. These compounds can be classified as those with ionic structure and those with metallic character. (J.S.R.)

16093 THE FORMATION OF SPHEROIDAL GRAPHITE IN THE URANIUM–CARBON SYSTEM. Philippe Guinet and Pierre Blum (Centre d'Études Nucléaires, Grenoble, France). Compt. rend., 252: 731-3(Jan. 30, 1960). (In French)

Graphite in a spheroidal form was observed in uranium–carbon systems with carbon concentration higher than 9%. The different aspects observed show that the formation of the spheroidal graphite can be explained in these alloys by the Stadelmaier theory. (tr-auth)

16094 STUDY OF THE FIRST STAGE OF NATURAL FRITTING IN THE γ PHASE OF URANIUM POWDER BY ISOTHERMAL DILATOMETRY. Bernard Pinteau, Georges Cizeron, and Paul Lacombe (École des Mines, Paris). Compt. rend., 252: 1149-51(Feb. 20, 1961). (In French)

Agglomerates made from non-alloyed uranium powder have a contraction which can not be neglected during thermal treatments in the γ phase. A dilatometric study of the kinetics of this contraction at different temperatures permitted the probable mechanism of first-stage fritting to be defined. The heat of activation of this process was determined. (tr-auth)

16095 EFFECTS OF RARE-EARTH SUBSTITUTIONS ON THE FLUORESCENCE OF TERBIUM HEXA-ANTIPYRINE TRI-IODIDE. R. R. Soden (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 32: 750-1(Apr. 1961).

Terbium hexa-antipyrine tri-iodide $[Tb(AP)_6I_3]$ forms well-defined crystals that fluoresce under ultraviolet (UV) light. Crystals are prepared of $Gd_{1-x}Tb_x(AP)_6I_3$, $Dy_{1-x}Tb_x(AP)_6I_3$, $Er_{1-x}Tb_x(AP)_6I_3$, and $Y_{1-x}Tb_x(AP)_6I_3$, with x values from 10^{-6} to 1. The relative fluorescence intensity under UV light of the resulting crystals to the pure $Tb(AP)_6I_3$ crystals at 5490A is studied, and the relative energy dissipation properties of Gd, Dy, Y, and Er are inferred from the results. (T.F.H.)

16096 LATTICE PARAMETER STUDIES OF IMPURITY EFFECTS ON PLASTIC PROPERTIES OF LITHIUM FLUORIDE. W. L. Phillips, Jr. (Du Pont de Nemours (E. I.) & Co., Wilmington, Del.). J. Appl. Phys., 32: 751-2 (Apr. 1961).

The lattice parameter (a) of LiF is found as a function of temperature and annealing method. Samples of LiF are cooled from 500°C to room temperature at varying rates. Values of a are measured as a function of temperature upon reheating from 0 to 700°C. Variations of the functional dependence of a on temperature between the slowly and rapidly cooled samples are examined in terms of impurity concentrations and agglomerations. (T.F.H.)

16097 HEAT CAPACITIES AND THERMODYNAMIC FUNCTIONS OF ZrH_2 AND ZrD_2 FROM 5 TO 350°K AND THE HYDROGEN VIBRATION FREQUENCY IN ZrH_2. Howard E. Flotow and Darrell W. Osborne (Argonne National Lab., Ill.). J. Chem. Phys., 34: 1418-25(Apr. 1961).

The heat capacities of ZrH_2 and ZrD_2 were measured in an adiabatic type calorimeter from 5 to 350°K. X-ray analyses showed the hydrides consist of a single face-centered tetragonal phase. The data for both compounds below 11°K were found to fit the equation $C_v = 9.8 \times 10^{-4} T + 464.6(T/\theta)^3$ cal deg^{-1} mole^{-1}, where $\theta = 311.4$, and this equation was used to extrapolate the heat capacities below 6°K. Between 20 and 100°K the C_p of ZrD_2 averages 1% lower than that of ZrH_2 but above 110°K the C_p of ZrD_2 becomes increasingly greater than that of ZrH_2. At 298.15°K the heat capacities and thermodynamic functions calculated from the data are $C_p = 7.396 \pm 0.015$ cal deg^{-1} mole^{-1}, $S° = 8.374 \pm 0.02$ cal deg^{-1} mole^{-1}, $H° - H_0^\circ = 1284.1 \pm 2$ cal mole^{-1}, and $(F° - H_0^\circ)/T = -4.067 \pm 0.01$ cal deg^{-1} mole^{-1} for ZrH_2, and 9.631 ± 0.019, 9.168 ± 0.02, 1474.4 ± 3, and -4.223 ± 0.01, respectively, for ZrD_2. The free energy of formation of ZrH_2 at 298.15°K is -30.9 ± 2 kcal mole^{-1} and that of ZrD_2 is -31.2 ± 2. On the assumption that the difference in the heat capacity between the two isotopic compounds arises from a triply degenerate hydrogen vibration, it was found that the difference in the temperature range 100 to 350°K could be satisfactorily fitted by the difference between two Einstein heat capacity functions with a frequency of 1190 ± 30 cm^{-1} for ZrH_2 and $1190/\sqrt{2}$ cm^{-1} for ZrD_2. This result is compared with the optical lattice vibration frequency found by neutron scattering experiments. (auth)

16098 X-RAY DIFFRACTION STUDY OF LIQUID MERCURY–INDIUM ALLOYS. Young Soo Kim, C. L. Standley, R. F. Kruh, and Glen T. Clayton (Univ. of Arkansas, Fayetteville). J. Chem. Phys., 34: 1464-5(Apr. 1961).

The intensity functions, distribution functions, and the fit of the first maxima with a sum of calculated contributions are graphically presented. The liquids had mole fractions of 1.0, 0.9, 0.7, 0.5, 0.3, and 0.0 in mercury. The temperatures were 23, 24, 24, 24, 140, and 175°C; and the densities 13.54, 12.76, 11.68, 10.28, 9.01, and 7.03 g/cm^3, respectively. The first maximum in each of the distribution functions is practically symmetrical and can be accounted for by assuming the same pair distribution exists over the entire composition range. (N.W.R.)

16099 AN INVESTIGATION OF COLUMBIUM AS AN ELECTROLYTIC CAPACITOR METAL. A. Shtasel and H. T. Knight (Fansteel Metallurgical Corp., Chicago). J. Electrochem. Soc., 108: 343-7(Apr. 1961).

The anodic oxidation characteristics of Nb metal are studied in relation to the manufacture of both wet and solid electrolytic capacitors. Capacitors prepared from Nb are very similar to those prepared from Ta except that the working voltages of the Nb capacitors are about one third and the d-c leakages about double those of similar Ta capacitors. Solid Nb capacitors are demonstrated to have an advantage over solid Ta capacitors in a severe nuclear environment. (auth)

16100 OXIDATION AND EQUILIBRIUM IN NONSTOICHIOMETRIC ZIRCONIUM DIOXIDE POWDER. Seymour Aronson (Westinghouse Electric Corp., Pittsburgh). J. Electrochem. Soc., 108: 312-16(Apr. 1961).

Two properties of nonstoichiometric zirconium dioxide powder are studied. Pressures of oxygen in equilibrium with ZrO_{2-x}, with $0.03 > x > 0$, are determined at temperatures of 900, 1000, and 1100°C by passing hydrogen-water vapor mixtures over the oxide. The measured pressures are in the range 10^{-20} to 10^{-12} atm. Rates of oxidation of $ZrO_{1.975}$ to ZrO_2 in oxygen are measured at 500 to 650°C. The activation energy for the oxidation, based on a diffusion mechanism, is 58.0 kcal/mole. A comparison of the rates of oxidation of $ZrO_{1.975}$ with the rates of oxidation of zirconium metal indicates that different mechanisms are operative. (auth)

16101 DENSITY AND PERMEABILITY RELATIONSHIPS IN FABRICATED BERYLLIA. J. S. O'Neill, A. W. Hey, and D. T. Livey (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 3: 125-37(Feb. 1961). (In English)

The permeability toward various gases of fabricated beryllia, ranging from 80 to 90% theoretical density, was measured. Permeability coefficients, B_0 and K_0, are calculated from the Carman equation and gas flow through beryllia is compared with that through graphite. The viscous permeability-density relationship for hot pressed beryllia is shown to be similar to that for metal powder compacts, and rapidly decreases to a negligible value at ≈95% theoretical density. Information on pore properties (number, size, and tortuosity) is obtained from permeability equations. For the specimen examined, the pores are ≈1 μ diameter, tortuous, and relatively few in number. Comparison is made with graphite, and the pore structure of beryllia is discussed. A minimum is observed in the plot of permeability coefficient (K) against mean pressure ($\bar{p}$) and an explanation is given in terms of pore size distribution for this and another type of observed plot. (auth)

16102 THE CRYSTALLOGRAPHIC DEPENDENCE OF LOW LOAD INDENTATION HARDNESS IN BERYLLIUM. N. A. Hill and J. W. S. Jones (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 3: 138-55(Feb. 1961). (In English). (AERE-R-3215)

Low load indentation hardness measurements on beryllium are markedly dependent on orientation and surface condition. Machining produces a uniform surface layer with a hardness of 300 DPN on both single and polycrystalline beryllium. Removal by etching of 0.02 cm (0.008 in.) of surface reveals the marked crystallographic dependence viz 230 DPN on the basal plane and 70 DPN on prism plane for a single crystal, and 300–170 DPN depending on the angle of testing relative to the surface for highly oriented sheet. These variations can be related to the operative deformation mechanisms in a single crystal and the preferred orientation in the sheet. Similar, but less marked effects are found in less highly oriented sheet, tube and rod; in all cases the maximum hardness corresponds to the greatest concentration of basal planes. Rotation of the diamond indenter in the basal plane of a single crystal gives no variation in hardness, but in both first and second order prism planes, there is a distinct variation which can be related to the beryllium crystal structure. (auth)

16103 THE EFFECT OF INCLUSIONS ON THE FRACTURE OF URANIUM. D. M. Davies and J. W. Martin (Oxford Univ.). J. Nuclear Materials, 3: 156-61(Feb. 1961). (In English)

A metallographic study was made of the nucleation and propagation of tensile fracture in the α-range of commercially pure uranium. The crack nucleus appears to be associated with the inclusions present, and the effect of prior annealing in the γ-range upon the size-distribution of these inclusions has also been studied semi-quantitatively. (auth)

16104 CREEP PROPERTIES OF A ZIRCONIUM–HYDROGEN URANIUM ALLOY. J. C. Bokros (General Atomic Div., General Dynamics Corp., San Diego, Calif.). J. Nuclear Materials, 3: 216-21(Feb. 1961). (In English)

The temperature and stress dependence of the steady-state creep rate of a zirconium–hydrogen–uranium alloy (atomic ratio of 1 : 1 : 0.03) was determined in the tempera-

ture range of 500° to 600°C which includes a eutectoid transformation. The stress (σ) dependence of the creep rate ($\dot{\epsilon}$) can be represented by an equation of the form: $\dot{\epsilon} = k\sigma^n$, with n = 4.1 below the transformation temperature and n = 4.7 to 4.9 above the transformation temperature. An activation energy of 80,000 cal/g atom was observed below the transformation temperature, whereas values of 65,000 to 73,000 cal/g atom were observed above the transformation temperature. (auth)

16105 MICROGRAPHIC OBSERVATION OF THE ALLOY Mg-0.6% Zr AFTER HEATING IN HYDROGEN. P. LeLong, J. Dosdat, J. Boghen, and J. Herenguel (Centre de Recherches, Antony, France). J. Nuclear Materials, 3: 222-34(Feb. 1961). (In French)

The structure of a Mg–0.6 wt.% Zr alloy after heating in hydrogen was studied with the optical and with the electron microscopes. The diffusion of hydrogen in this alloy brings about a precipitation of zirconium hydride which separates in the form of flat hexagonal plates. The effects of such precipitation are principally of two types: anchoring of the grain boundaries leading to a "blocked" microstructure, the formation of hydride being irreversible and the speed of coalescence extremely slow, and precipitation hardening when the hydride particles are sufficiently fine. These two effects related to the distribution, the number and size of the precipitates are dependent on various metallurgical factors and on the conditions of hydriding. (auth)

16106 TEMPERATURE DEPENDENCE OF THE SLIP DIRECTION FOR {110} SLIP IN α-URANIUM. L. T. Lloyd (Argonne National Lab., Ill.), P. Lacombe, D. Calais, and N. Simenel. J. Nuclear Materials, 3: 241-5(Feb. 1961). (In English)

A dynamic argument is developed to explain the different results obtained in compression and tensile deformation of {110} slip from -196 to 600°C. {110} slip is observed at high temperature in a <110> direction and at room and at low temperatures in a [001] direction. Partial dislocations in uranium {110}–[001] slip may be the result of two successive {110}–<112> slips. (N.W.R.)

16107 CAVITY GROWTH BY VACANCY CONDENSATION AND TRANSFORMATION TO DISLOCATION LOOP IN THE GRAPHITE STRUCTURE. Takuro Tsuzuku (Nihon Univ., Tokyo). J. Phys. Soc. Japan, 16: 407-13(Mar. 1961). (In English)

The growth of cavities by vacancy condensation in graphite and the transformation to dislocation loops are theoretically investigated. During the heat treatment of carbonaceous substances for graphitization, numerous vacancies and cavities presumably exceeding 10^{-3} at.% are introduced in several ways, e.g., decomposition and evaporation of various impurities. By taking account of the internal surface energy and the configurational entropy of the cavities, it is found that these vacancies and cavities are driven to consolidate to fewer and larger ones lying extensively on the (001)-planes. In the course of the steady dimensional growth, the cavity is expected to collapse to a prismatic dislocation loop under the compressive thermal stress in c-direction (graphitization stress) caused by the interference between the anisotropically expanding crystallites. The criterion of this transformation is found by comparing the self-energy of the dislocation loop with the sum of the surface energy of the original cavity and the compressive strain energy to be released by the collapse; i.e., the critical diameters vary from about 100 to 1100 A in accordance with the various conditions concerning the crystal modification and the cavity thickness. (auth)

16108 MAGNETIC PROPERTIES OF PEROVSKITES CONTAINING STRONTIUM. II. LANTHANUM–STRONTIUM MANGANITES. Hiroshi Watanabe (Tohoku Univ., Sendai, Japan). J. Phys. Soc. Japan, 16: 433-9(Mar. 1961). (In English)

Magnetic and crystallographic properties are studied of the system $(La_{1-y}Sr_y)MnO_x$ with varying values of y and x. It is found that the compounds with y = 1 crystallize in perovskite-like structures providing that x is lower than a certain limit. Perovskite-like $SrMnO_x$, containing both Mn^{3+} and Mn^{4+} does not show any spontaneous magnetization above the liquid-N temperature, and its paramagnetic Curie temperature is negative, in contrast with the ferromagnetic behavior observed in La-rich manganites. Hence in these compounds no evidence of strong positive Mn^{3+}–Mn^{4+} interaction is obtained. The susceptibility measurements show that Mn^{3+}–Mn^{3+} interaction in Sr-rich cubic perovskite is negative. (auth)

16109 THE FERROELECTRIC PHASE TRANSITION IN $(GLYCINE)_3 \cdot H_2SO_4$ AND CRITICAL X-RAY SCATTERING. Iwao Shibuya and Toshio Mitsui (Pennsylvania State Univ., University Park). J. Phys. Soc. Japan, 16: 479-89 (Mar. 1961). (In English)

On the assumption that the ferroelectric phase transition in $(Glycine)_3 \cdot H_2SO_4$ is of the order-disorder type, expressions for Bragg reflections and critical scattering of x rays are given in terms of a long-range order parameter and pair correlation functions. Temperature dependence of the critical scattering is discussed on the basis of the Bragg-Williams approximation and of a modified Fröhlich theory. Experimental observations agree with theoretical predictions, and prove that the phase transition is of the order-disorder type. The observed critical scattering exhibits a pronounced peak at the Curie point, suggesting that the local field theory is not a good approximation. The shape of the peak appears to be quite different from that in the ferromagnetic case. It is found that the sulfur atoms do not shift appreciably when the glycine groups rotate. A method for evaluating the pair correlation function is proposed. (auth)

16110 GROWTH KINETICS AND THE PROPERTIES OF DIFFUSION LAYER ON THE PHASE BOUNDARY BETWEEN URANIUM AND ALUMINUM. Vladimír Kraus. Jaderná energie, 7: 48-53(Feb. 1961). (In Czech.)

Quantitative and qualitative analyses of diffusion processes occurring on the phase boundary between U and Al at higher temperatures are carried out. The samples consist of plane-parallel discs of pure metals that are pressed, sealed into evacuated ampules of heat resisting glass and annealed in the temperature range 273 to 454°C. The maximum rate of growth of an intermetallic phase layer may be found using the penetration coefficient value $A_0 = 1.27 \cdot 10^{-3}$ $cm^2 \cdot sec^{-1}$ and the activation energy Q = 11,000 cal/g-atom. Three-fourths of the thickness of the intermetallic phase layer is on the Al side. X-ray diffraction analysis proves the existence of phases of UAl_3 and some UAl_2 in the diffusion layer formed at 400°C. (auth)

16111 THE OXIDATION AND CARBURIZATION OF THIN FILMS OF ALUMINUM AND BERYLLIUM. Jean-Jacques Trillat, Lea Tertian, and Monique Bonnet-Gros (C.N.R.S., Bellevue, France). Mém. sci. rev. mét., 57: 845-51(1960). (In French)

The carburization of Al and Be was followed by electron microscopy by duplicating in the electron microscope the conditions necessary for reciprocal diffusion between a film of carbon and a layer of the metal vapor deposited on a carbon membrane. As the carburization, especially in the

case of beryllium, was accompanied by the formation of oxides, the results relative to the oxidation of Al and Be heated under different pressures of residual air were first reported. It was found that at pressures of 10^{-5} mm Hg oxidation of aluminum could not be prevented. It was found that the Be is oxidized progressively with a badly crystallized BeO appearing at 200°C, well crystallized at 550 to 600°C. It is necessary to reach 900°C before only the polycrystalline BeO can be observed. The identification of C_3Al_4 and the presence of γ alumina at 900°C was discussed in some detail. In the carburization of Be, first the appearance of the oxide is observed and then abruptly a new diagram is observed, which is interpretated as a mixture of BeO and Be_2C. No characteristic structure connected to the carburization was found. (J.S.R.)

16112 EFFECT OF ALPHAGENIC ELEMENTS ON THE DIFFUSION OF COPPER IN GAMMA IRON. F. Sirca (Univ. of Ljubljana, Yugoslavia). Mem. sci. rev. met., 57: 879-87(1960). (In French)

It has been observed that the presence of small quantities of phosphorus causes a profound modification in the diffusion of copper in γ iron. To determine if the other alphagenic elements had a similar effect, studies were made with copper containing 2% antimony, tin, chromium, phosphorus, silicon, beryllium, aluminum, or arsenic. The diffusion of pure copper in pure iron was first studied. Then the effect of alphagenic elements on the diffusion was investigated. Finally, a study was made of the diffusion of copper in different austenitic and ferritic alloys. The results show that the crystalline lattice of iron plays an essential role in the diffusion of copper in iron. Below the A_3 transformation temperature of iron, the copper diffuses in α iron in a frontal manner, whereas above this temperature the copper penetrates the γ iron intergranularly. The presence of other elements in the crystalline lattice of iron does not change this characteristic fact. The diffusion of copper in alloyed steels of the ferritic type is strongly frontal, whereas the alloyed steels of the austenitic type show intergranular diffusion of copper. In the case where the copper contains low quantities of an alpha genic element which diffuses in the iron more rapidly than the copper, the diffusion of copper in the γ iron becomes frontal. The explanation of this phenomenon is that the alphagenic element diffuses first in the γ iron and transforms it progressively into α iron. In such a body-centered iron, the copper does not penetrate intergranularly, but in a frontal manner. (J.S.R.)

16113 THE 47-SEC NUCLEAR ISOMER IN IRIDIUM. Hans-Henning Hennies and Arnold Flammersfeld (Universität, Göttingen, Ger.). Naturwissenschaften, 48: 97(1961). (In German)

The interpretation given by the previous authors on the study of the 47-sec activity in iridium can not be proven. For instance, in measurements of the γ intensity in the energy range from 100 to 450 kev of an Ir sample exposed to slow neutron, the decay of the 47-sec activity can be followed for more than three lifetimes. The study was made with two different measurement arrangements, and equal results were obtained. The γ spectrum measured is so different from the Rh γ spectrum that possible Rh impurities are ruled out. (J.S.R.)

16114 CERAMICS-THERMAL CONDUCTIVITY. G. Artnur (Parsons Nuclear Research Centre). Nuclear Eng., 6: 138-42(Apr. 1961).

The thermal conductivity (K_T) and the various factors governing K_T are examined for ceramic materials, and a method for maximizing K_T is suggested. Nuclear applications are stressed. (auth)

16115 SPECTRAL STRUCTURE OF NEUTRAL AND IONIZED OSMIUM. Th. A. M. Van Kleef and P. F. A. Klinkenberg (Universiteit, Amsterdam). Physica, 27: 83-94(Jan. 1961). (In English)

An analysis of the Os I and Os II spectra is reported. Of a total number of 263 Os I levels 155 can be interpreted in terms of the quantum theory. The ground level system is associated with the electron configurations $5d^66s^2$ and $5d^76s$, which are strongly intermingled. Of the $5d^8$-configuration, however, no trace has been found. In the odd system most levels can be assigned to multiplets of the configurations $5d^66s6p$, $5d^56s^26p$ and $5d^76p$. Many of the high even states are attributed to the configurations $5d^66s7s$, $5d^56s^27s$ and $5d^66s6d$. The number of classified Os I lines is about 40% of the total number known. For the ionization potential of the Os-atom a value of (8.5 ± 0.1) v is found. The main progress in the analysis of Os II is the definite establishment of $5d^56s^2\ {}^6S_{5/2}$ and the identification of $5d^56s(^7S)6p\ {}^8P_{5/2,7/2,9/2}$. Approximately 15% of all known Os II lines above 2000 A are classified. Energy levels of Os I and Os II with observed J- and g-values and quantum assignments are presented. (auth)

16116 THE RELATIONSHIP BETWEEN POWDER PROPERTIES AND THE PRESSING AND SINTERING BEHAVIOUR OF BERYLLIUM. A. J. Martin and G. C. Ellis (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Powder Met., No. 7, 120-38(1961).

Existing routes for the preparation of beryllium powders are surveyed, and comments are made on the effect of certain properties, such as particle-size distribution, on the compaction by different techniques. It is emphasized that particle size, degree of oxidation, and overall purity are interdependent variables, and that little attempt has been made to study their effects separately. (auth)

16117 RELATIONSHIP BETWEEN THE PROPERTIES OF TANTALUM AND NIOBIUM POWDERS AND THEIR SINTERING BEHAVIOUR. Jiri Vacek (Powder Metallurgy Research Inst., Prague). Powder Met., No. 7, 156-66(1961).

Experiments were carried out to determine the relationship between the properties of tantalum powder and its compressibility, and to examine the effect of carbon and niobium on the hardness and tensile and electrical properties of semi-manufactured products of tantalum. The influence of the particle-size distribution of niobium powder upon the properties of sintered bars was also studied, with particular reference to the problem of swelling of the bars during sintering. (auth)

16118 THE EFFECT OF SURFACE CHARACTERISTICS ON THE SINTERING OF URANIUM AND BERYLLIUM POWDERS. J. Williams, J. W. S. Jones, and K. H. Westmacott (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Powder Met., No. 7, 167-88(1961).

Studies of the sintering of uncompacted uranium powders in vacuum show that sintering behavior is markedly affected by the nature of the surface films on the powder. Of the variables in the powder-production route that might affect the nature of the surface films, the leaching stage is the most important. The deleterious effect of surface contaminants on the vacuum-sintering behavior of beryllium is demonstrated. During the development of a technique for the production of a stable powder from electrolytic flake, the nature of the leaching treatment again proved to have a marked influence on the sintering behavior of the resultant powder. Both sets of investigations were ham-

pered by lack of methods for identification of surface films on powders. (auth)

16119 THE ELECTRICAL RESISTIVITIES AND MAGNETIC SUSCEPTIBILITIES OF SOME STABLE AND METASTABLE URANIUM–MOLYBDENUM ALLOYS. L. F. Bates and R. D. Barnard (Univ. of Nottingham, Eng.). Proc. Phys. Soc. (London), 77: 691-9(Mar. 1, 1961).

The magnetic susceptibilities and electrical resistivities of a series of quenched γ body-centered cubic U-Mo alloys are measured over the temperature ranges 293 to 1200°K and 90 to 1200°K, respectively. Alloys containing 15, 20, and 25 at.% Mo each possess a small negative temperature coefficient of resistivity below about 200°C in the metastable γ-state, and a positive coefficient in the stable γ-region. All samples exhibit a Pauli weak spin paramagnetism which increases with temperature, and in addition possesses an exchange contribution shown to be independent of composition over the range 15 to 30 at.% Mo. The results are correlated with the electronic structure of the γ-alloys. (auth)

16120 THE LUMINESCENT DECAY OF VARIOUS CRYSTALS FOR PARTICLES OF DIFFERENT IONIZATION DENSITY. J. C. Robertson and J. G. Lynch (Glasgow Univ.). Proc. Phys. Soc. (London), 77: 751-6(Mar. 1, 1961).

Measurements of the decay of the luminescence produced in LiI(Eu), NaI(Tl), KI(Tl), CsBr(Tl) and 3 CsI crystals of varying Tl concentration are made for particles with different ionization densities. The decay time of the luminescence is found to depend on the average ionization density ρ. In all cases except LiI(Eu), 2 components are found in the decay. The dependence of the decay times, of the efficiencies and of the relative voltage pulse height per unit energy on Tl concentration for different particles is studied in CsI. The ratio τ_e'/τ_α' increases with the average Z of the crystal where τ_e' and τ_α' are the average decay times for electrons and α-particles respectively. (auth)

16121 LINEAR THERMAL EXPANSIONS OF GRAPHITIC MATERIALS. A. S. Fialkov and Ya. G. Davidovich. Zhur. Priklad. Khim., 34: 300-6(Feb. 1961). (In Russian)

The linear thermal expansion of graphitic materials was studied as a function of their composition. It was found that an increase in linear thermal expansion takes place with an increase in density. Linear thermal expansions of natural graphite powders from various deposits are discussed. (R.V.J.)

16122 IMPROVEMENTS IN ALLOYS. (to Union Carbide Corp.). British Patent 863,357. Mar. 22, 1961.

An alloy is described whose oxidation resistance is good at temperatures up to and above 1100°C and which can be heat treated with conventional means. This alloy contains or may contain Ti, Fe, Cr, V, W, Ta, Ni, Co, Nb, Ba, Si, Be, Y, B, and the rare earth metals. The maximum benefits of the alloy are obtained when the alloy consists of 5 to 20, 15 to 25, 5 to 30, 0 to 10, 0 to 20, 0 to 20, 0 to 15, and 0 to 3 wt.% of Ti, Fe, Cr, V, W, Ta, Ni and/or Co, and one or more of Ba, Si, Be, Y, B, and the rare earth metals, respectively, with the remainder being Nb in an amount of at least 40 wt.%; the aggregate of V, W, and Ta must not exceed 30 wt.%. In fabricating the alloy, care should be taken to protect the metals from atmospheric contamination. Four examples of the alloy are given, and oxidation data are given for temperatures of 800, 1000, and 1200°C. (D.L.C.)

16123 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR CONTROL ROD MATERIALS. Terence Stanley Busby and Mervin Wyndham Davies (to General Electric Co., Ltd.). British Patent 865,226. Apr. 12, 1961.

A reactor control rod material is described which can withstand high temperatures without corrosion or pollution of the reactor coolant. The material is a ceramic containing boron oxide and one or more of the oxides of Mg, Ca, Al, and Si, with the boron content in the range 12 to 35 at.%. Possible ways of forming shaped pieces of this ceramic are discussed. A reactor control rod configuration using the ceramic is described which consists of annular units of the ceramic contained within a tube, casing, and cap, all of stainless steel. (D.L.C.)

Radiation Effects

16124 (BSR-439) ELECTRONIC CIRCUIT RESEARCH AND DEVELOPMENT FOR NUCLEAR PROPELLED VEHICLES. Interim Engineering Report No. 1, October 1, 1960 to January 1, 1961. R. C. Green (Bendix Corp. Bendix Systems Div., Ann Arbor, Mich.). Contract AF33(600)-42262. 195p. (BSC-23203)

To show how the radiation resistance of electronic equipment can be increased, a mission and traffic control subsystem was modified for radiation resistance and then tested. The subsystem contained the following: marker beacon receiver, uhf transceiver, radio receiving set, TACAN transceiver, air-to-ground identification set, radio beacon, and air-to-air identification system. The results are summarized for the following pieces of electronic equipment: transformers (power, audio, pulse), relays, and capacitors (Ta, Nb, film, mica). Materials to be avoided in construction of the above pieces are given. Cannon connectors and transistors were also radiation-tested. (D.L.C.)

16125 (DP-549) THE EFFECT OF GAMMA RADIATION ON ION EXCHANGE RESINS. Linda Lou Smith and Harold J. Groh (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Feb. 1961. Contract AT(07-2)-1. 14p.

The cation exchange resins, Dowex 50W-X12 and Duolite C-10, and the anion exchange resins, Dowex 1-X4, Dowex 1-X8, and Permutit SK, were irradiated up to a gamma dose of 2.7×10^8 rad and the resulting changes in their total ion exchange capacity, salt-splitting capacity, moisture content, and particle size were measured. The results indicate that Dowex 50W-X12 and Permutit SK are the most stable of the cation and anion exchange resins, respectively. The main source of radiation damage to cation exchange resins of the sulfonated polystyrene type is in breaking of cross-linkages, while quaternary amine anion resins suffer damage through degradation of functional groups. (D.L.C.)

16126 (GA-2065) STABILITY OF BeO–UO_2 REACTOR FUEL MATERIAL DURING IRRADIATION. MARITIME GAS-COOLED REACTOR PROGRAM. Dale E. Johnson (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Mar. 31, 1961. Contract AT(04-3)-187. 23p.

Fuel pellets composed of 19 vol.% UO_2 dispersed in a beryllium oxide matrix were irradiated to an exposure of approximately 2×10^{20} fissions/cm^3 at an estimated pellet temperature of 2200° to 2300°F. The UO_2 was present in the form of irregularly shaped grains of approximately 125 μ average diameter. No significant change in the dimensions of the pellets or in the lattice parameters of the beryllia matrix was observed. The crushing strength of the pellets and their resistance to abrasion were reduced as a result of the irradiation. (auth)

16127 (HW-68747) IRRADIATION EFFECTS IN CORE STRUCTURAL MATERIALS. S. H. Bush (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 6, 1961. 24p.

The influence of reactor environment on significant properties of various structural materials is discussed. Typical applications of metals and alloys in reactors include the pressure vessel, pressure tubes, channels, fuel cladding, and fuel element hardware. Materials used for the applications are the low alloy steels, 300-series stainless steels, 400-series stainless steels, the high nickel alloys, beryllium, zirconium and its alloys, niobium alloys, aluminum and magnesium and their alloys. Specific metals which were selected include: A212B steel, 304SS, 410SS, Inconel-X, beryllium, Zircaloy-2, niobium, 1100 aluminum, and Magnox. The properties in structural materials affected by irradiation which are of concern to the reactor designer include tensile measurements, impact-energy transition temperatures, fatigue, creep, thermal conductivity, and corrosion. Critical parameters influencing some or all of these properties are grain size, level of cold work, recovery characteristics, degree of metastability, neutron flux energy spectrum, integrated neutron flux, exposure temperature, and environment. In addition, conditions such as load rate during tensile testing may influence the results. Because of the many variables and inadequate reporting of such factors as grain size, microstructure, flux energy spectrum, loading rates, and temperatures, much of the information available can be used qualitatively only. Specific examples of such data and general trends are presented covering aluminum, A212B steel, 304SS, 410SS, Inconel-X, Zircaloy-2, Magnox, niobium, and beryllium. Representative examples of changes in tensile and impact properties are presented graphically. (auth)

16128 (LMSD-48361) PHYSICS OF THE IONIZATION PROCESSES IN AIR. Interim Report. R. E. Meyerott, R. K. M. Landshoff, and John Magee (Lockheed Aircraft Corp. Missile System Div., Sunnyvale, Calif.). Dec. 12, 1958. Contract AF29(601)-512. 40p.

An investigation was made of the response of air to ionizing radiation, where the energy absorbed is insufficient to cause an appreciable temperature change. Air which is subjected to weak fluxes of such radiation is found to emit a characteristic fluorescent radiation and is ionized. The number of ion pairs produced in air is known to be insensitive to the energy of the radiation. Discussions are given of the response of air to electrons having initial energies of a kev or higher, and secondary molecular processes involving atoms, molecules, and ions. (B.O.G.)

16129 (NAA-SR-Memo-6156) THORIA: A SELECTED BIBLIOGRAPHY. M. Bloomfield (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 20, 1961. 9p.

A bibliography is presented, consisting of 126 references, relating primarily to radiation effects of thorium oxides. Some references are included dealing with determination, physical properties, preparation, production, and reprocessing of ThO_2. (B.O.G.)

16130 (NP-9927) EFFECT OF RADIATION ON THE MECHANICAL PROPERTIES OF STEELS. Bibliography. Lew F. Porter, comp. (United States Steel Corp., Pittsburgh). Feb. 7, 1961. 8p.

16131 (NP-9953) LITERATURE SURVEY ON EFFECTS OF NUCLEAR RADIATION TO ELECTRON TUBE MATERIALS. Final Report, February 1, 1957–October 31, 1960. E. R. Johnson (Stevens Inst. of Tech., Hoboken, N. J.). Contract DA-36-039-SC-73146. 43p.

Results of a literature study on the effects of nuclear radiation on electron-tube materials are presented. The induced radioactivity, on a per gram basis, of the elements commonly found in electron tubes after exposure to a thermal neutron flux of 10^{16} neutrons/cm^2 for 5 min. was determined. Radiation effects on metals, glass, special materials, minerals, and ceramics are discussed. Special effects of radiation damage, manufacture variability, dosimetry, radiation damage to electron tubes, gas evolution, and static testing of tubes are also described. (M.C.G.)

16132 (NP-9957) MONTHLY ACCESSION LIST NO. 45 [ON RADIATION EFFECTS DATA]. Period Covered February 1–February 28, 1961. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Mar. 15, 1961. Contracts AF33(616)-7375 and AF33(616)-6564. 18p.

16133 (NRL-5582) PRELIMINARY OBSERVATIONS ON THE EFFECTIVENESS OF HEAT TREATMENT FOR THE RECOVERY OF PROPERTIES OF IRRADIATED STEELS. J. R. Hawthorne and L. E. Steele (Naval Research Lab., Washington, D. C.). Nov. 16, 1960. 13p.

Investigations on the effects of neutron radiation on steels used in nuclear-reactor construction revealed that under certain exposure conditions the notch-ductility properties of the materials may be severely deteriorated. In seeking a method for restoring the initial material properties by a means within reactor operational capabilities, the possibility of using postirradiation heat treatment is being examined. Initial observations indicate that heat treatment is effective in recovery of notch-ductility properties of irradiated materials, the extent of recovery being strongly dependent upon irradiation temperature. (auth)

16134 (NYO-8005) TEMPORARY AND PERMANENT EFFECTS PRODUCED BY RADIATION ON SOLIDS. BEHAVIOR OF MOLECULES ON ELECTRON IMPACT. Bruce W. Steiner and John Turkevich (Princeton Univ., N. J.). June 30, 1956. Contract AT(30-1)-1158. 138p.

Radiation damage to solids involves the primary act of ionization or mechanical rupture of the molecule; decomposition of the ionized molecule into fragments such as ions, radicals or smaller molecules; reaction between the fragments; and neutralization of the fragments. Mass spectrometry offers direct evidence into the first two steps of radiation damage. For in the mass spectrometer molecules can be subjected to controlled electron bombardment under conditions such that the third and fourth step does not occur. There is a minimum of collisions between the fragments and half of the products, the charged particles, are detected and identified before neutralization. Neutral fragments from a complex molecule are not detected and their nature must be deduced from the nature of the charged particles. A literature survey of one hundred twenty five compounds of varying chemical structure has shown that the efficiency of ionization does not depend on the number of electrons in the molecule but on the geometrical cross section of the molecule. A correlation has been made of the types of ions produced by electron bombardment of normal paraffins, methyl octanes, normal olefines, isomers of heptene and nonene, normal acetylenes, saturated and unsaturated cyclic hydrocarbons, and aromatic hydrocarbons. Furthermore the effect of functional derivatives such as amines, alcohols, aldehydes, ketones, acids, esters, ethers, and halogen derivatives was also studied. The mass spectra of twenty compounds were determined. These include 1-octanol, octanaldehyde, 2-octanone, octanoic acid, methyl octanoate, octyl acetate, methyl-n-octyl ether, n-octyl amine, 1-bromo-octane, 1-chloro-octane, 1-iodo-octane, nitrobenzene, anisole, p-nitroanisole, m-nitroanisole, o-nitroanisole, o-fluoro-anisole, methyl cyclohexyl ether, and nitrocyclohexane.

On the basis of the results it was established that the electrical polarity of functional groups exerts a strong influence on the type of ions produced. 53 references. (auth)

16135 (NYO-9515) SYNTHESIS OF SEMICONDUCTOR MATERIALS BY RADIATION INDUCED REACTIONS. Quarterly Status Report No. 7, November 1, 1960–January 31, 1961. Kalman Held and Richard Goldman (TRG, Inc., Syosset, N. Y.). Contract AT(30-1)-2392. 21p. (TRG-132-QTR-7)

Studies were continued on the radiation- and thermal-induced decomposition of silane at 325 and 350°C. A preliminary value of G = 33 was obtained for silane. (B.O.G.)

16136 (TID-5366) A SURVEY OF THE RADIATION STABILITY OF JET FUELS. Report No. 9. J. G. Carroll, R. O. Bolt, and J. A. Bert (California Research Corp., Richmond). June 30, 1956. Decl. Feb. 2, 1961. Contract AT(11-1)-174. 38p.

Seven fuels were exposed to gamma radiation. The fuels included stove oil, furnace oil, JP-3, JP-4, JP-5, kerosene, and aviation gasoline. The latter four were also irradiated in the Materials Testing Reactor. For neutron-irradiated fuels, viscosity and gassing information was obtained. For the gamma-irradiated samples, several physical properties were obtained by micro methods, including ASTM distillation. For one kerosene-type fuel, sufficiently large quantities were gamma-irradiated so that thermal stability tests were run in the Erdco Fuel Coker. The shielding properties of the fuels as measured by hydrogen content were not altered by radiation, although density increased and weight per cent hydrogen decreased. Irradiation broadened the boiling range of the fuels. Without exception, distillations of irradiated fuels showed an increase in high-boiling point fractions; in a few cases, low-boiling point fractions also increased. Olefins were formed due to the loss of hydrogen from paraffinic hydrocarbons. Aromatic content was not increased appreciably by irradiation. Gas evolution may be a problem with fairly low radiation dosages. Viscosity change was not large below 10^9r. Thermal stability was impaired at 10^8r, though data were scant. (auth)

16137 (TID-11034) IRRADIATION DAMAGE TO GLASS. J. Raymond Hensler, Norbert J. Kreidl, and Eberhardt Lell (Bausch and Lomb Optical Co., Rochester, N. Y.). November 1960. 47p. Contract AT(30-1)-1312.

The detailed analysis of impurity centers in fused silica was investigated by the examination of radiation induced absorption bands in fused silica doped with Al in combination with all the alkalies through cesium. The combination of alkalies and gallium show how gallium can substitute for aluminum in the impurity center with some limitations, related probably to the variation in ionic radii. The interaction of cesium with these centers is shown clearly in some preliminary experiments which appear to indicate some preferential association of cerium with the color center or its precursor. (W.L.H.)

16138 (TID-12162) EFFECT OF NEUTRON IRRADIATION ON THE PLASTIC DEFORMATION OF COPPER SINGLE CRYSTALS. I. G. Greenfield and H. G. F. Wilsdorf (Franklin Inst. Labs. for Research and Development, Philadelphia). [1960]. 48p.

Copper single crystals, subjected to a neutron dose of 3×10^{18} nvt (total flux) at pile temperature, were examined after deformation by: observation of the load-extension relations, investigation of the slip line structures with the electron microscope, and diffraction electron microscopy of thinned-down single crystals before and after deformation. From the experimental data and results of previously published information, a mechanism for radiation hardening of copper was devised. Prismatic dislocation loops, apparently caused by condensation of vacancies, are found to be the most frequently produced radiation defect. The interaction between loops and glide dislocations results in heavily kinked dislocations which are responsible for the observed high yield stress. Processes are considered in which glide dislocations remove the radiation damage, and because of this cleaning out of radiation produced defects and the ability of the dislocations to multiply from new sources, the prolonged easy glide range can be explained. The proposed mechanism provides for an understanding of the work hardening in the linear and parabolic parts of the stress-strain curve. (auth)

16139 (TID-12368) STORED ENERGY RELEASE BELOW 80° IN DEUTERON IRRADIATED COPPER. Technical Report No. 24. T. G. Nilan and A. V. Granato (Illinois. Univ., Urbana). Feb. 1961. Contract AT(11-1)-182. 95p.

Measurements were made of the release of stored energy during the annealing of deuteron-irradiated copper. The irradiation was carried out with 11.0-Mev deuterons at a temperature of less than 10°K. The specimen was annealed at an approximately constant rate from 15 to 80°K. A differential thermometry technique employing two closely matched specimens, one of which was irradiated, was used to measure the energy release. Loss corrections and heat capacities were determined experimentally for the annealing temperature range. The average energy release between 25 and 55°K, for a normalized integrated flux of 10^{17} 10-Mev deuterons per cm^2, was 0.83 ± 0.04 calorie per gram. The following experimental ratios were obtained: 7.1 cal/gm energy release per $\mu\Omega$ cm recovery and 4.2 ev energy release per atomic volume recovery. This indicated that the recovery takes place by means of discrete processes describable by first order kinetics. The characteristic activation energies of these processes are sufficiently separated from each other at low temperatures to permit experimental resolution. A mathematical description of the recovery under first order kinetics is given, and, upon application to the data available, the frequency factor of recombination was found to be about 10^{12}. The possibility of an energy release in irradiated copper similar to that observed in irradiated graphite is discussed. It was concluded that recovery is due to the recombination of isolated interstitial-vacancy pairs and correlated interstitial recombination. (M.C.G.)

16140 (TID-12491) A STUDY OF THE EFFECTS OF NUCLEAR RADIATION ON ORGANIC EXPLOSIVES. M. J. Urizar, E. D. Loughran, and L. C. Smith (Los Alamos Scientific Lab., N. Mex.). [1960?]. 41p.

Samples of 6 explosive compounds (TNT, tetryl, NC, ROX, HMX, and PETN) and 4 explosive mixtures were exposed to the neutron and gamma radiation from a power reactor at integrated flux levels of approximately 10^{15} and 3×10^{16} n/cm^2. The irradiated samples were subjected to a variety of chemical and physical tests. Only minor effects were noted at the lower exposure level, but extensive deterioration of the aliphatic and and heterocyclic compounds occurred in the 10^{16} run. G-values of 2.9 and 1.4 were obtained for the destruction of ROX and HMX, respectively. An experiment in which samples of 5 explosive compounds and mixtures were exposed to a radiation burst from the Godiva II critical assembly is described. No significant damage to the samples resulted from this exposure. (auth)

16141 (VDIT-16.1) RADIATION EFFECTS ON SOLID URANIUM-BASED NUCLEAR FUEL MATERIALS. A

Bibliography. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Jan. 1961. 73p.

This bibliography contains material on radiation effects on solid U-based nuclear fuel materials available in 1959 and 1960. The material is arranged under eight headings: general, referring to publications and surveys generally pertinent to the subject; metallic uranium; binary alloys; ternary alloy; other alloys; oxide (ceramics); carbide; and dispersion fuels, consisting chiefly of cermets. (M.C.G.)

16142 (AEC-tr-4328) MECHANICAL PROPERTIES AND MICROSTRUCTURE OF SOME STRUCTURAL MATERIALS AFTER IRRADIATION BY NEUTRONS. I. M. Voronin, V. D. Dmitriev (Dmitriyev), Sh. Sh. Ibragimov, and V. S. Lyashenko. Translated by J. Woroncow from Atomnaya Energ., 8: 514-18(June 1960). 8p. (XDC-60-10-157)

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 19516.

16143 (AEC-tr-4425) RELAXATION OF ELASTIC STRESSES UNDER NEUTRON IRRADIATION. S. T. Konobeevskii. Translated from Atomnaya Energ., 9: 194-200 (1960). 25p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 723.

16144 (CEA-tr-R-1029) SUR LE CALCUL DES CHANGEMENTS DE VOLUME DES METAUX SOUS L'EFFECT DU RAYONNEMENT NEUTRONIQUE. (Calculation of Volume Variations of Metals Under the Effect of Neutron Radiation). Yu. I. Remnev. Translated into French from Vestnik Moskov. Univ., Ser. Fiz.-Mat. i Estestven. Nauk, 1: 23-6(1959). 8p.

A process is given for the theoretical determination of the volume increase which occurs in a crystalline body (metal) under the effect of neutron irradiation. (J.S.R.)

16145 DEFORMATION UNDER IRRADIATION OF URANIUM AT LOW TEMPERATURE. Yves Quéré and Jacques Doulat (Centre d'Etudes Nucleaires, Saclay, France and Centre d'Etudes Nucleaires, Grenoble, France). Compt. rend., 252: 1305-7(Feb. 27, 1961). (In French)

The "growth" of uranium under reactor irradiation was studied at the temperature of liquid hydrogen. The growth coefficient was measured for cold-worked uranium and for uranium annealed at 600°C. It was found that the coefficient is considerably larger at low temperatures than at room temperature, and it is larger for cold-worked uranium than for annealed uranium. (J.S.R.)

16146 MOBILITY OF RADIATION-INDUCED DEFECTS IN GERMANIUM. P. Baruch (Bell Telephone Labs., Murray Hill, N. J.). J. Appl. Phys., 32: 653-9(Apr. 1961).

The motion of irradiation-produced defects in Ge is observed under the influence of the electric field of a reverse-biased p-n junction. The defects are created with 1-Mev electrons or Co^{60} γ-rays, and the spatial distribution of the defects is obtained from the bias dependence of the junction capacity. Motion in the electric field is observable between 40 and 70°C and corresponds to negatively charged centers with a mobility of 2.6×10^{-14} cm^2/v sec at 65°C. The activation energy of the mobility is about 1 ev. The centers are assumed to anneal thermally. No effect is found for defects that anneal at lower temperatures. (auth)

16147 FREQUENCY FACTORS FOR ANNEALING FAST-NEUTRON INDUCED DENSITY CHANGES IN VITREOUS SILICA. William Primak (Argonne National Lab., Ill.), Herman Szymanski, and David Keiffer. J. Appl. Phys., 32: 660-8(Apr. 1961).

Isothermal and step-annealing data show that the frequency factor (A) is $\sim 10^{14}$/sec for processes having activation energies beyond the peak of the distribution. A is some orders of magnitude lower and possibly dispersed for activation energies below the peak of the distribution. (auth)

16148 ELECTRON SPIN RESONANCE IN A GAMMA-IRRADIATED SINGLE CRYSTAL OF THIODIGLYCOLIC ACID. Yukio Kurita and Walter Gordy (Duke Univ., Durham, N. C.). J. Chem. Phys., 34: 1285-91(Apr. 1961).

The electron spin resonance of a gamma-irradiated single crystal of thiodiglycolic acid was measured at room temperature at 9 kMc. From the analysis of the anisotropy in the spectroscopic splitting factor and in the nuclear hyperfine interaction constants, a model of the free radical HOOC—CH_2—S—CH—COOH is proposed. In this free radical, the electron spin density is mainly in a π orbital, about 60% of which is the p orbital of the CH carbon, 2% is the 1s orbitals of the CH_2 hydrogens, and 22% is in the p orbital of the S. (auth)

16149 THERMAL RESTORATION OF PARAMETERS OF WEAKLY IRRADIATED UO_2. J. Bloch (Centre d'Etudes Nucleaires, Saclay, France). J. Nuclear Materials, 3: 237-8(Feb. 1961). (In French)

The restoration of crystalline parameters by isochronous annealing was investigated in a UO_2 sample for which the relative parameter variation had reached a maximum of 8.6×10^{-4}. The irradiation was done in the EL2 reactor at 2.5×10^{12} n/cm^2 sec for 7 days, or an integrated flux of 1.48×10^{18} n/cm^2. The temperature remained below 62°C. The results show that restoration took place in two principal stages: one beginning at 200° the other at 500°C. The only possible explanation for the variation of the parameter is the formation of point defects by irradiation which disappear upon annealing. (T.R.H.)

16150 FERROELECTRIC PROPERTIES OF X-RAY DAMAGED ROCHELLE SALT. Kenkichi Okada (Aichi-Gakugei Univ., Nagoya, Japan). J. Phys. Soc. Japan, 16: 414-23(Mar. 1961). (In English)

X-radiation damage in rochelle salt is studied experimentally and theoretically. Observed double hysteresis loops are explained as superpositions of two biased single loops. Each biased single loop corresponds to each of the two oppositely polarized domains of which the crystal is composed. Single domain crystals show biased single loops when damaged, and the internal bias thus induced can be compensated by an external d-c biasing field. The Curie point of the damaged crystal compensated by this external field, however, is lower than that of the virgin crystal by ΔT, which depends upon the x-ray dosage. In this respect the damage effect differs from the stress effect. It is assumed that the irradiation gives rise to polar anisotropy centers which produce effective bias fields in undamaged ferroelectric regions. Irradiation time dependencies of the spontaneous polarization, the coercive field, and the internal bias are studied. A phenomenological theory is developed to explain the various phenomena. The polarization within the polar anisotropy center is estimated to be the order of 100 esu near the shifted Curie point. (auth)

16151 A THEORY OF ELECTRON IMPACT ON SOME POLYATOMIC MOLECULES. Tsutomu Watanabe (Univ. of Tokyo). J. Phys. Soc. Japan, 16: 510-28(Mar. 1961). (In English)

A method is obtained that yields the mass spectral pattern of a polyatomic molecule from data of appearance potentials of various ions and data of optical measurements. It is predicted that the total molecular ionization cross sections and relative yields of ions do not depend on the incident energy, except in the low incident energy region, and

at the total cross section does not always rise linearly th the increase of incident energy at a threshold. Appli- tions to CH_4 and CD_4 are carried out and the results are agreement with mass-spectroscopic data. Two ionized ates ($^2A_1$, $^2T_2$) are taken into account; it is assumed that e potential energy surfaces of ionized states are not very ferent from those of the ground states of the parent olecules with respect to all but 1 or 2 normal modes. is also found that we have a larger abundance of parent n in the CD_4 case than in the CH_4 case by isotope effect. uth)

16152 ON THE ADDITIVITY RULE IN THE IONIZATION CROSS SECTION OF MOLECULES. Tsutomu atanabe (Japan Atomic Energy Research Inst., Tokyo). Phys. Soc. Japan, 16: 529-33(Mar. 1961). (In English)

The validity of the additive rule in the ionization cross ection of molecules is investigated. The rule is deter- lined to be approximately valid within 20% with the condi- on that electrons have incident energies >80 ev and that e internuclear distance between every pair of atoms in a olecule is more than $2.5a_0$. If the internuclear distance is ss than $2.5a_0$, the diffraction effects due to the interfer- nce of waves scattered by the neighbor atoms must be ac- ounted for. Numerical computations are carried out in the ases of C_nH_{2n+2} and C_nF_{2n+2}. The results for C_nH_{2n+2} are n agreement with mass spectroscopic data but those for $_nF_{2n+2}$ are in slight disagreement with data. (auth)

16153 THE EFFECT OF NEUTRON IRRADIATION OF BERYLLIUM. R. S. Barnes (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Eng., 6: 149-0(Apr. 1961).

Properties of Be as thermal reactor canning and struc- ural material are examined. The effects of fast neutron ombardment on Be^9 are studied, particularly for the reac- ions $Be^9(n,2n)2\,He^4$ and $Be^9(n,\beta^-)He^4 + Li^8$. The effects of nterstitials and vacancies, dislocations, trapped He^4 atoms, nd temperatures are studied for fast neutron doses of $>10^{20}/cm^2$; changes in Be physical properties under these loses are given. (T.F.H.)

16154 RADIATION DAMAGE IN SOLIDS. Douglas S. Billington and James H. Crawford, Jr. Princeton, N. J., Princeton University Press, 1961. 457p.

A survey of radiation damage is presented, with an evalu- ation of various experimental techniques and radiation sources in current use. Investigations on four general classes of solids are conducted: metals, alloys, covalent crystals, and ionic crystals. Special attention is devoted to radiation damage of semiconductors, uranium, and graphite. (T.F.H.)

16155 PROCEEDINGS OF THE SECOND CONFERENCE ON NUCLEAR RADIATION EFFECTS ON SEMICONDUCTOR DEVICES, MATERIALS AND CIRCUITS, SEPTEMBER 17th AND 18th, 1959, NEW YORK. Samuel L. Marshall, ed. New York, Cowan Publishing Corp., 1960. 128p.

Twenty three papers were presented. The conference was sponsored by the Office of the Director of Defense Research and Engineering. Twenty of the 23 papers have been abstracted separately. (T.F.H.)

16156 A BRIEF RESUME OF RADIATION EFFECTS ON SEMICONDUCTOR MATERIALS AND DEVICES. Joseph J. Loferski (RCA Labs., Princeton, N. J.). p.8-10 of "Proceedings of the Second Conference on Nuclear Radiation Effects on Semiconductor Devices, Materials and Circuits, September 17th and 18th, 1959, New York."

Transient and permanent radiation effects on semiconductor materials, mainly Ge and Si, and devices are reviewed. Radiation effects on Fermi and energy levels are discussed, and the implications of semiconductor radiation-effect data on transistors, solar cells, and other devices are examined. (T.F.H.)

16157 HIGH-ENERGY ELECTRON IRRADIATION OF GERMANIUM AND SILICON. H. Roth and V. A. J. Van Lint (General Atomic Div., General Dynamics Corp., San Diego, Calif.). p.11-13 of "Proceedings of the Second Conference on Nuclear Radiation Effects on Semiconductor Devices, Materials and Circuits, September 17th and 18th, 1959, New York."

The high-energy electron irradiation effects on the electrical properties of single crystals of Ge and Si are studied. A 2 to 32 Mev electron linear accelerator is used with peak currents up to 300 ma. The conductivity, Hall effect, and carrier lifetime are found as a function of radiation dosage. The interpretation of the results after long irradiations is complicated by the existence of a number of observed phenomena which can be ascribed to minority carrier trapping. Lifetime versus temperature measurements taken after irradiation by 10^{13} 27 Mev electrons/cm^2 yield 0.27 ev for the energy difference between the trapping levels and the top of the valence band. The initial rates of carrier removal under irradiation by 27 Mev electrons are found to be 2.9 carriers/cm^3/electron/cm^2 in n-type Ge at 83°K, and 0.24 carriers/cm^3/electron/cm^2 in n-type Si at 26°C. (auth)

16158 THE NATURE OF A NON-EQUILIBRIUM EXCESS CONDUCTANCE INDUCED IN SILICON BY NUCLEON IRRADIATION. T. A. Longo (Sylvania Advanced Device Research Lab., Northlake, Ill.) and E. Y. Wang. p.14-17 of "Proceedings of the Second Conference on Nuclear Radiation Effects on Semiconductor Devices, Materials and Circuits, September 17th and 18th, 1959, New York."

Transient changes in the properties of semiconductor devices after nucleon irradiation are reported. Similar non-equilibrium effects in the electrical properties of high resistivity Si are observed at room temperature after electron and deuteron irradiations. Excess conductance that under certain conditions requires hours to decay is produced; it is most pronounced in n-type Si. It is shown that the effects can be duplicated in irradiated samples by ultraviolet illumination and can be also obtained with ultraviolet illumination of non-irradiated Au doped n-type Si having 10^5 ohm-cm resistivity at room temperature. It is concluded that the non-equilibrium phenomena are due to surface conditions; a model is presented in which the effects may be attributed to holes trapped in outer surface states, i.e., states on the outside of the oxide surface layer. Variation of the surface sensitivity with various surface treatments is also shown. (auth)

16159 TRANSIENT RADIATION EFFECTS IN SEMICONDUCTORS. Victor A. J. van Lint (General Atomic Div., General Dynamics Corp., San Diego, Calif.). p.18-21 of "Proceedings of the Second Conference on Nuclear Radiation Effects on Semiconductor Devices, Materials and Circuits, September 17th and 18th, 1959, New York."

Transient conductivity changes are observed in Ge crystals and p-n junction diodes. The excitation is produced by a short pulse (0.2 to 5 μsec) of 2 to 32 Mev electrons. In pure crystals at low radiation intensities, measurements of the relaxation time of the transient conductivity are used to determine the carrier lifetime. Recombination phenomena at high injection levels can also be studied. p-n junctions exhibit such phenomena as an open circuit voltage (analogous to photovoltage), short circuit current, enhanced reverse current, or prolonged recovery time when placed in a high

impedance reverse-biasing circuit. These manifestations are related to the recombination time in the base-material of the diode by both theory and experiment. (auth)

16160 POSITIVE ION BOMBARDMENT OF METALS WITH RADIOACTIVE KRYPTON-85. H. M. DeAngelis and Irving Feuer (Air Force Cambridge Research Center, Bedford, Mass.). p.22-3 of "Proceedings of the Second Conference on Nuclear Radiation Effects on Semiconductor Devices, Materials and Circuits, September 17th and 18th, 1959, New York."

Kr^{85} is used to bombard Pt and Si specimens at 500 to 2500 v in order to determine bombardment uniformity, and to measure the number of bombarding gas atoms trapped during bombardment. In bombardments at 500 v there is evidence of a low plasma density discharge and autoradiographs show uniform deposition of Kr in the target surfaces. A Si specimen bombarded for 300 sec at 500 v and a current density of ~3 $\mu a/cm^2$ traps 9×10^{13} atoms of Kr. Annealing studies are made on specimens bombarded at 500 and 2500 v; a considerable portion of the trapped Kr atoms are retained even after prolonged heating at high temperatures. (auth)

16161 ELECTRON IRRADIATION EFFECTS IN CdS. B. A. Kulp and R. H. Kelley (Aeronautical Research Lab., Wright Air Development Center, Wright-Patterson AFB, Ohio). p.31-4 of "Proceedings of the Second Conference on Nuclear Radiation Effects on Semiconductor Devices, Materials and Circuits, September 17th and 18th, 1959, New York."

The threshold for displacement of the S atom from a lattice point in CdS is measured to be 8.7 ev. This is the threshold for the production of green edge emission centers and of centers for a red fluorescence band with a maximum intensity at about 7200A. In crystals which show edge emission before bombardment, the edge emission is removed by electron bombardment in the energy range 15 to 200 kev. The red luminescence is not removed by electron bombardment. This radiation "annealing" of the edge emission is accomplished even in crystals which do not thermally anneal. On the basis of the radiation annealing effect, a model is proposed with the sulfur interstitial atom the center for edge emission, and the sulfur vacancy the center for the red emission band. Experimental verification of the model is presented. (auth)

16162 MINORITY CARRIER LIFETIME IN NEUTRON-BOMBARDED GERMANIUM. A. E. Walters (Bell Telephone Labs., Inc., Whippany, N. J.). p.35-8 of "Proceedings of the Second Conference on Nuclear Radiation Effects on Semiconductor Devices, Materials and Circuits, September 17th and 18th, 1959, New York."

The junction recovery technique is employed to obtain a series of measurements of minority carrier lifetimes concurrent with fast neutron bombardment. The samples include n-type Ge crystals with initial resistivities of 0.40, 5.8, 7.2, and 32 ohm-cm and p-type Ge crystals with initial resistivities of 0.76, 9.5, 18, and 40 ohm-cm. The crystals are in the form of grown-junction bars dimensioned so that surface recombination is negligible for bulk lifetimes less than 500 μsec. The measured dependence of minority carrier lifetime on integrated fast neutron flux is in good agreement with values derived from device measurements and with previously reported direct measurements. During exposure no annealing of bombardment-introduced recombination centers is observed. (auth)

16163 CORRELATION OF THEORETICAL AND EXPERIMENTAL BEHAVIOR OF SILICON JUNCTION DIODES DURING NEUTRON AND GAMMA IRRADIATION. M. A. Xavier (Century Electronics and Instruments, Inc., Tulsa, Okla.). p.39-48 of "Proceedings of the Second Confer on Nuclear Radiation Effects on Semiconductor Device Materials and Circuits, September 17th and 18th, 1959, New York."

The behavior of Si diodes during irradiation is exam in terms of the theory for basic diodes and radiation-induced effects in bulk semi-conductor materials. Two device models are used to consider different types of d odes, and the forward and reverse characteristics of diodes during irradiation are developed for these 2 dioc models. Correlation between the semi-quantitative diod theory and experimental data shows that the effects of n clear radiation on Si diodes are relatively predictable. Ranges of neutron doses providing consistent performan are shown to be related to the device properties. The be havior of Si zener reference elements is also determine from device considerations. The results of irradiations 32 devices of 2 different types are presented. Technique are discussed for increasing radiation tolerance of the devices and the consistency between devices of the same type. The effects of temperature combined with radiatio are examined. (auth)

16164 STUDY DIRECTED TOWARD IMPROVING TH RADIATION TOLERANCE OF SILICON DIODES. Geral Huth (General Electric Co., Evendale, Ohio). p.49-61 of "Proceedings of the Second Conference on Nuclear Radia tion Effects on Semiconductor Devices, Materials and Ci cuits, September 17th and 18th, 1959, New York."

Results are presented of a series of irradiations which are conducted to delineate the factors affecting tolerance Si semiconductor diodes to nuclear radiation. Included a the effects of varying the width of the base region, compa ison of diffused and alloy junction devices having similar electrical characteristics, and comparison of the behavio of diode characteristics at low and high forward current levels. The effect of varying the width of the base region also analyzed using basic device equations. All irradiatio are conducted in the same reactor position to facilitate valid relative comparisons among experimental devices. From the data of the irradiations, conclusions as to what would probably represent the optimum configuration with respect to tolerance to nuclear radiation are reached. Such units are constructed and irradiated; the results are presented. (auth)

16165 PRELIMINARY STUDY OF THE EFFECTS OF EXPOSURE OF ELECTRONICS COMPONENTS TO 2-MEV ELECTRONS AND OTHER KINDS OF RADIATION. F. N. Coppage (Sandia Corp., Albuquerque, N. Mex.). p.62-70 of "Proceedings of the Second Conference on Nuclear Radiation Effects on Semiconductor Devices, Materials and Circuits, September 17th and 18th, 1959, New York."

Electronics components, including coaxial cables and Ge and Si diodes, which are subjected to 2 Mev electrons, to a Co^{60} γ-source, and to neutrons in order to obtain an engineering correlation of effects between electron radiation and neutron radiation, and in order to determine whether the radiation tolerance of the device or material is increased by prior irradiation. It is found that similar types of effects occur from both electron and neutron radiation, and that a correlation is possible. Furthermore, it is found that in many instances neutron radiation tolerance can be increased by means of prior irradiation with electrons or other forms of radiation. (auth)

16166 RADIATION EFFECTS ON SEMICONDUCTORS. David Pomeroy (Hughes Aircraft Co., Culver City, Calif.). p.71-4 of "Proceedings of the Second Conference on Nuclear Radiation Effects on Semiconductor Devices, Ma-

als and Circuits, September 17th and 18th, 1959, New k."

he transient and permanent effects of radiation on semi-luctors are treated. The method of measurement is dis-sed and sample calculations are made. These calcula-s illustrate the rate effect of pulsed sources on thin Si Ge wafers and the absorbed dose effects due to passage ough the inner (proton) Van Allen radiation belt, and an imation of the lifetime of transistors in such excursions. "Relative Transient Radiation Effectiveness" as a asure of the relative transient damage to materials due to ious ionizing radiations is introduced. (auth)

67 THE EFFECTS OF NUCLEAR RADIATION ON ME SELECTED SEMICONDUCTOR DEVICES. G. Levy, R. Fouse, and S. V. Castner (Marquardt Aircraft Corp., n Nuys, Calif.). p.76-81 of "Proceedings of the Second nference on Nuclear Radiation Effects on Semiconductor vices, Materials and Circuits, September 17th and 18th, 59, New York."

Two groups of tests performed at the Convair GTR facil- are described. The tests are specifically designed to tain engineering data on the effect of fast neutron irradia-n on selected semiconductor devices. Items tested in-ded diodes, Zener diodes, infrared sensors, and recti-rs. Fluxes and doses are both reported. (auth)

168 GAMMA IRRADIATION EFFECTS ON INFRA-ED DETECTORS. John F. Ready (Honeywell Research nter, Hopkins, Minn.). p.82-6 of "Proceedings of the cond Conference on Nuclear Radiation Effects on Semi-nductor Devices, Materials and Circuits, September 17th nd 18th, 1959, New York."

Semiconductor infrared detectors are irradiated in a Co^{60} -ray facility. The detectors irradiated are indium antimo-ide single crystal photoelectromagnetic and PbTe evapo-ated film photoconductive types. Following irradiation to n integrated dosage of 2.3×10^7 r, the noise equivalent ower of the indium antimonide cells is not significantly ffected. The noise equivalent power of the PbTe cells is eriously impaired following exposure to 8.4×10^6 r. Meas-rements during irradiation, at the beginning of the irradia-ion, indicate negligible effect on the performance of the letectors in the radiation field at a dose rate of 3×10^5 r/hr. The expected performance of the detectors in other types of radiation environments is discussed. (auth)

16169 ANALYSIS OF SIMPLE RECTIFYING AND MAG-NETIC AMPLIFIER CIRCUITS DURING IRRADIATION. M. A. Xavier (Century Electronics & Instruments, Inc., Tulsa, Okla.). p.92-5 of "Proceedings of the Second Conference on Nuclear Radiation Effects on Semiconduc-tor Devices, Materials and Circuits, September 17th and 18th, 1959, New York."

The application of criteria for the primary types of de-vice failure to simple circuits indicates that these different types of failure bring about different circuit effects. Si and Ge diodes are considered in simple circuits involving half-wave and bridge rectification as well as in basic half-wave magnetic amplifier circuits. Comparison of dynamic be-havior during irradiation with equivalent circuit predictions shows that behavior of the circuits is relatively predictable. Methods of obtaining improved circuit and system perform-ance with existing devices include the use of increased cir-cuit voltages and low lifetime devices. The use of diffused junction devices promises more consistent device, and therefore circuit, behavior during irradiation. (auth)

16170 TRANSISTOR CIRCUIT BEHAVIOR AT EXPO-SURES GREATER THAN 10^{15} FAST NEUTRONS CM^{-2}. R. R. Blair, W. P. Knox, and J. W. Easley (Bell Telephone Labs., Whippany, N. J.). p.96-101 of "Proceedings of the Second Conference on Nuclear Radiation Effects on Semi-conductor Devices, Materials and Circuits, September 17th and 18th, 1959, New York."

A Ge diffused-base transistor with a very high transport-factor frequency cut-off exhibits a near-minimum sensitivity to neutron bombardment, considering minority-carrier tran-sistor structures as fabricated by contemporary techniques. Measurements of device electrical characteristics concur-rent with bombardment indicate that circuit operation should be possible to fast neutron exposures in the decade between 10^{15} and 10^{16} fast neutrons cm^{-2}. Values of maximum ex-posure in this range for any particular circuit depend on the mode of operation of the transistor. The inpile behav-ior of a high-frequency oscillator, amplifier and bistable circuit element is examined at fast neutron flux values of the order of 10^{11} neutrons cm^{-2} sec^{-1}. The results of these examinations in conjunction with those of the bombardment behavior of the device electrical characteristics are dis-cussed. (auth)

16171 RADIATION RESISTANT DIGITAL COMPUTER CIRCUITRY. M. Ball, W. A. Bohan, G. E. Boyd, and J. D. Maxey (International Business Machines Corp., Owego, N. Y.). p.102-6 of "Proceedings of the Second Conference on Nuclear Radiation Effects on Semiconductor Devices, Materials and Circuits, September 17th and 18th, 1959, New York."

The problems involved in the operation of a transistorized digital computer in a high nuclear flux are discussed. The transistor radiation damage theory which leads to the devel-opment of more radiation resistant circuitry is presented. Three circuits, a flip-flop, a pulse amplifier, and a pulse gate, which employ the improvements suggested by the tran-sistor theory are described. The procedure and results of a series of tests on 3 circuits in a high neutron and γ-ray flux environment are presented. (auth)

16172 A TRANSISTOR SCALER CIRCUIT FOR A MEGARAD GAMMA-RAY ENVIRONMENT. E. R. Rathbun, S. A. Yefsky, C. G. Polak (Cook Research Labs., Div. of Cook Electric Co., Chicago). p.111-15 of "Proceedings of the Second Conference on Nuclear Radiation Effects on Semi-conductor Devices, Materials and Circuits, September 17th and 18th, 1959, New York."

A circuit is designed, constructed, and tested that proves the possibility of collecting and recording pulse rate data while exposed to a γ-radiation environment. The system is designed to function in a γ-radiation environment, accepting and counting pulses in a multistage binary scaling circuit, transferring the information on the number of pulses from the several binary stages to a magnetic tape recorder, clearing the circuit for the next word, and repeating the process in accordance with a previously prepared program. Resistance to elevated temperatures up to 100°C is also in-corporated in the design. Because of power limitations, the use of transistors is imperative. Adequacy of the design is demonstrated in a 12.3 hr exposure to a 52,000 c Co^{60} source of γ-radiation which produces an accumulated dose equivalent to 1.85×10^6 r, and by heating to 100°C in an environmental oven. (auth)

16173 PROBLEMS OF CORRELATING RADIATION ENVIRONMENTS. Jerome Rothstein (Edgerton, Ger-meshausen, and Grier, Inc., Boston). p.116-19 of "Pro-ceedings of the Second Conference on Nuclear Radiation Effects on Semiconductor Devices, Materials and Circuits, September 17th and 18th, 1959, New York."

A review and analysis of environmental, material, and device variables and their mutual interactions is made. The results indicate the need for very great caution in correlating different environments but give solid grounds for hoping that a reasonable basis for such correlation can be established. Some preliminary experimental results obtained with pulsed nuclear reactors indicate that over a substantial range in intensity and pulse duration meaningful correlations can be made. (auth)

16174 THE EFFECT OF INTERMITTENT IRRADIATION ON THE MAGNETIC REMANENCE OF A FERRITE. G. C. Bailey and E. I. Salkovitz (U. S. Naval Research Lab., Washington, D. C.). p.120-2 of "Proceedings of the Second Conference on Nuclear Radiation Effects on Semiconductor Devices, Materials and Circuits, September 17th and 18th, 1959, New York."

The magnetic remanence of a Ferramic G ferrite is measured as a function of irradiation time in the NRL reactor. During the experiment the reactor is operated at 100 kw, 8 hours a day, 5 days a week. The results indicate that the damage is accumulative over the 4 weeks of intermittent irradiation and that the observable recovery occurs within the initial 2 hr period immediately following reactor shutdown each day. This suggests that equilibrium is attained within 2 hr, and that no further recovery occurs thereafter. (auth)

16175 SEMICONDUCTOR DEVICES AS CHARGED PARTICLE DETECTORS AND ENERGY SPECTROMETERS. Stephen S. Friedland (Nuclear Electronics Lab., Hughes Aircraft Co., Culver City, Calif.) and Frank Keywell. p.123-8 of "Proceedings of the Second Conference on Nuclear Radiation Effects on Semiconductor Devices, Materials and Circuits, September 17th and 18th, 1959, New York."

The feasibility of the detectors, operating at room temperatures, for the detection of α particles, protons and fission fragments is demonstrated. Neutron detection may be accomplished using enriched B, the various isotopes of U, and other fissionable elements. The linearity of pulse height with energy of the incident particle is available, at present, over a limited range; however, various methods of extending the range are now under investigation. A 2-dimensional mosaic of detectors is made which may eliminate the use of the photographic plates in α-ray spectrometers and other similar instruments. The possibility of a current gain by utilizing the transistor action is being explored. A study of the properties of p-i-n detectors for high energy protons and α's and for the detection of β particles, ultra-violet and γ radiation is underway. (auth)

PHYSICS

General and Miscellaneous

16176 (AD-243696) XM-731 PLASMA ENGINE R&D PROGRAM. Second Quarterly Progress Report, September 30. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio). Contract AF33(616)-7176. 23p.

The experimental and theoretical programs for investigating the operation of the continuous crossed field MHD plasma accelerator were extended. High electron current flow was attained at the cathode of the accelerator. An accelerator model was developed and satisfactorily operated demonstrating the feasibility of the proposed concept. A new accelerator test facility was constructed. A means for the measurement of plasma velocity by the Doppler shift principle is outlined. The Hall and end effect problem is discussed. Current distributions at the accelerator ends are shown for the special case of uniform magnetic field. The reduction of accelerator efficiency as a result of the Hall effect is also shown in graphical form. (auth)

16177 (ANL-6288) PHYSICS DIVISION SUMMARY REPORT, JANUARY–FEBRUARY 1961. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 35p.

Activities are outlined in various areas of effort including experimental nuclear physics, mass spectroscopy, and general theoretical physics. Separate abstracts were prepared for each paper. (J.R.D.)

16178 (BRL-1122) THE AXISYMMETRIC MODES OF VIBRATION OF THIN SPHERICAL SHELL. Wilfred E. Baker (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Dec. 1960. 62p.

A detailed study is presented of the theory of free, axisymmetric vibrations of thin elastic spherical shells. It is demonstrated by experiment that the normal modes of vibration predicted by theory do exist. The theory, which is an expansion of an ancient study by Lamb, predicts the existence of two infinite sets of normal modes, one of which is bounded in frequency and the other unbounded. The first four modes in each set are identified by experiments on a small steel shell. (auth)

16179 (IG-Report-51) THERMAL CONDUCTIVITY DETERMINATIONS ON URANIUM DIOXIDE BY A RADIAL FLOW METHOD. V. C. Howard and T. F. Gulvin (United Kingdom Atomic Energy Authority. Industrial Group. Culcheth Labs., Culcheth, Lancs, England). Nov. 17, 1960. 7 p. (NPCC-FEWP/P.700)

Thermal conductivities in the temperature range 100 to 1000°C were determined by a radial flow method for five specimens of uranium dioxide of 95% theoretical density prepared made by different production routes. The temperature variation of conductivity of nominally stoichiometric UO_2 can be expressed in the form of thermal conductivity k = $1/(A + 0.084\ T\ (°K))$ (cal cm^{-1} sec^{-1} deg C^{-1}), where A is a constant for each material and dependent on the method of production. A has a value of 12 for material produced by the high-temperature route and for cold-compacted powder directly sintered in cracked ammonia at 1700°C. A lies between 30 and 36 for material produced by the low-temperature route and for cold-compacted non-stoichiometric powder sintered in argon at 1400°C for 2 hr and reduced in hydrogen at 1400°C for 2 hr. The dependence of the constant A on UO_2 structure is discussed. The factors considered most likely to contribute to the value of A are slight departures from stoichiometric composition, microcracking in specimens, and factors dependent on production methods. (auth)

16180 (IS-216) THE MASS SPECTRUM OF STANNANE. Fred Eric Saalfeld and H. J. Svec (Ames Lab., Ames, Iowa). Nov. 1959. Contract W-7405-eng-82. 40p.

The mass spectrum of stannane, SnH_4, was studied. Ion fragmentation patterns for both the singly and doubly charged fragments were obtained employing 70-volt electrons. An estimation of the bond energies of the tin-hydrogen bond in the ion-species SnH_3^+-H, SnH_2^+-H, SnH^+-H, Sn^+-H was made along with ΔH_f for SnH_4. The studies were first made with tin of normal isotopic abundance, and then the results were corroborated with SnH_4 prepared with the separated isotope Sn^{120}. (auth)

16181 (NP-9803) DEVELOPMENT OF AN ION PROPELLANT SYSTEM. Quarterly Technical Progress Report No. 3, September 15, 1960–December 15, 1960. P. J. Lawlor and M. W. Mueller (Thompson Ramo Wooldridge Inc., Cleveland). Dec. 30, 1960. Contract AF33(616)-7219. 21p. (ER-4294)

A discussion is given of work accomplished in the operation of a cesium vaporizer, the development of a cesium pump and valve, and the handling of cesium. Tests were conducted on the vaporizer operations with and without the cesium pump. Cesium pump test characteristics are given for the flow of cesium and oil for single and double bellows operation. Design criteria are given for the cesium valves, one is to operate in liquid at 150°F, while the other operates in vapor at 1100°F. (B.O.G.)

16182 (NP-9935) QUARTERLY PROGRESS REPORT NO. 60. J. B. Wiesner, G. G. Harvey, and H. J. Zimmermann (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Jan. 15, 1961. Contract DA36-039-sc-78108. 268p.

A review of the research activities of the laboratory for the three-month period ending November 30, 1960 is presented. Progress is indicated in the fields of physical electronics, plasma dynamics, solid-state physics, low-temperature physics, statistical thermodynamics, microwave spectroscopy, nuclear magnetic resonance and hyperfine structure, microwave electronics, molecular beams, thermoelectric processes and materials, stroboscopic research, modulation theory and systems, statistical communication theory, process analysis and synthesis, processing and transmission of information, artificial intelligence, physical acoustics, speech communication, signal detection by human observers, mechanical translation, linguistics, communications biophysics, neurophysiology, neurology, circuit theory and design, noise in electron devices, network synthesis, sensory aids research, computer study of the dynamics of a national economy, and computer components and systems. (M.C.G.)

16183 (NP-9955) THE MICROWAVE FARADAY EFFECT IN WEAKLY MAGNETIC GASES. Martin L. Sage

(Harvard Univ., Cambridge, Mass. Mallinckrodt Chemical Lab.). [1959?]. 16p.

The microwave Faraday Effect is proposed as a method of measuring rotational magnetic moments in gases. The theory of the Faraday Effect is developed using the method of Karplus and Schwinger. It is applied near a microwave absorption frequency of the gas. The magnitude of the effect indicates that the Faraday Effect may be a more satisfactory method of measuring small, less than 0.1 nuclear magneton, magnetic moments than the Zeeman Effect. It requires intensity rather than frequency measurements and so is difficult. (auth)

16184 (NP-9994) TRANSIENT AND STEADY STATE BEHAVIOR IN CESIUM ION BEAMS. J. M. Sellen and H. Shelton (Ramo-Wooldridge. Div. of Thompson Ramo Wooldridge Inc., Canoga Park, Calif.). 1960. Contract AF49(638)-886. 63p. (TN 60-1395 and RW-RL-186)

Presented at the American Rocket Society Electrostatic Propulsion Conference, Monterey, California, November 3-4, 1960.

The transient and steady-state behavior in high-purveance cesium ion beams was investigated. Steady-state beams with unipolar flow characteristics exhibited the effects of radial spreading and the phenomena associated with the formation of a virtual source. It was demonstrated that such steady-state unipolar beams may be generated, but the necessary conditions in order to prevent trapped electrons from obscuring the positive space charge fields were such that it is unlikely that the high-voltage purveance beams encountered in propulsive applications may be operated under laboratory conditions without the collection of this trapped negative charge. The formation of this colony of trapped electrons was studied in pulsed ion beams. The transmission of the ion beam through the trapped electrons was observed to be oscillatory. The plasma was characterized as unstable against this oscillatory behavior. The frequency of the oscillation was measured. An analysis was made of the energy of the ions as they arrived at the collector. A single narrow energy "line" was observed with the beam in a non-oscillatory condition. With the beam in oscillation, the energy spectrum was broadened. An electron beam probe was employed to probe the ion beam. A mechanism is outlined to account for the oscillation, the emission of light, the dispersion and reduction in the ion energy, and the observed behavior in the probing electron beam. A search for oscillations at the electron plasma frequency was conducted with negative results. A beam of ions and electrons exhibited a stable non-oscillatory behavior in an experiment in which the collector was allowed to float. (M.C.G.)

16185 (NP-10015) RESEARCH SUMMARY NO. 36-7, VOLUME II, FOR THE PERIOD DECEMBER 1, 1960 TO FEBRUARY 1, 1961. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Mar. 1, 1961. Contract NASw-6. 41p.

Physical Sciences. The upper atmosphere density curve of the Earth was used as a model upper atmosphere for Mars, and the variation of atmospheric density with height was calculated for Mars. The molecular dissociation rate in the Martian atmosphere was also calculated. The night airglow expected for Mars is discussed and compared with that of Earth. Solutions of the neutron transport Boltzmann equation are given for spherical symmetry with no inside sources and compared with the plane solutions of Case. A comparison of power-to-weight ratios for different fission electric cell reactor geometries for space applications was made which indicates that the increase of electrical efficiency in changing from plane to cylindrical and spherical electrodes are largely cancelled by the decrease in the fuel surface-to-void volume ratio. The liquid sodium flow facility constructed to test some of the approximations made magnetofluiddynamics and some of the tests planned are scribed. A piezoelectric probe for measuring static pressure fluctations in turbulent air flow and the problems involved are discussed. Engineering Mechanics. The tensile properties of pyrolytic graphite were measured at room temperatures and at 3000 to 5000°F. Bulk and CCl_4 density measurements before and after tensile deformation of graphite show a decrease in the bulk density at all temperatures and no change in the CCl_4 density up to 5000°F, above which an increase occurs. Tests were run in which graphite was prestrained at 5000°F and its tensile strength measured at 4000°F; the results indicate that such pretreatment increases the strength by 2 to 4 times. The thermal conductivities and diffusivities of three plastics (polyethylene, polytetrafluoroethylene, and polymethylmethacrylate) were measured with a transient heating method and a tungsten lamp furnace. Input power and voltage-current characteristic data are presented for 600-kw plasma generator using argon as working fluid, a thoriated tungsten cathode, and a sonic exit nozzle. A modified variable end point method was developed for solving boundary value problems in systems of ordinary differential equations. The present computer situation in the Jet Propulsion Laboratory is discussed, and a general-purpose digital data logging system suitable for use with IBM 7090 computers is described. An analytic study was made on the problem of temperature control in space with three heat sources: sun, stars, and a nuclear reactor. Equilibrium temperatures and particle flux densities are calculated for a solid cube subjected to radiation from each source. The results are discussed with respect to shielding and establishing cryogenic temperatures. The present status of pressure vessel analysis is described. The magnitude of a trapped magnetic field in a collision-dominated plasma and related properties are calculated, and it is shown that a leaking of the interior field results in a rotation of the plasma. Engineering Facilities. The air flow field in a 20-in. supersonic wind tunnel was recalibrated, and variations in pressure and Mach number on the tunnel centerline are given for 19 calibrated Mach numbers. Test runs were made on the Ranger RA-1 proof test model and temperature control model in a space simulator at 2×10^{-5} mm Hg pressure and various temperatures. A portable oil film table for component vibration testing in the horizontal plane was constructed and found to be superior to a right-angle adapter. Propulsion. The experimental performance of the RMIR Injector 7 injecting $N_2O_4 + N_2H_4$ into a 20-in. L* chamber was measured and compared with the theoretical performance and with data obtained for a 40-in. chamber and other propellants and injectors. The difficulty of measuring the nozzle inlet stagnation pressure is discussed. Heat transfer tests were made at a 39.7-in. chamber length; the results are in good agreement with the analytical predictions except in the nozzle contraction region. The maximum experimental heat flux values are plotted as a function of chamber pressure for 23.7 and 39.7-in. L* tests, and it is concluded that change of L* has no effect on local heat flux. Mass and performance estimates are presented for a $N_2H_4-N_2O_4$ propulsion system, and payload masses are given for various system parameters for high- and low-energy Mars orbits. (D.L.C.)

16186 (NP-10071) SUPERCONDUCTIVITY 1959–1961 An Annotated Bibliography. A. A. Beltran, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Feb. 1961. 187p. (SB-61-11)

Current theory, properties, and applications of superconductors as presented in the literature from 1959 to Feb

ary 1961, are covered in this annotated bibliography. The 5 entries, representing English and foreign language publications, are grouped into six major topics with subdivisions into specific subjects. Author and subject indexes are given to facilitate location of specific items. (auth)

16187 (NRL-Memo-1127) STATUS REPORT ON THERMOELECTRICITY. J. W. Davisson and Joseph Sasternak (Naval Research Lab., Washington, D. C.). Dec. 1960 and Jan. 1961. 97p.

The results of previous investigations on the thermal conductivity and thermoelectric power generation of thermoelectric materials are summarized. Data on tellurides and sulfides, semiconductor materials, silicides, ceramics, and other materials are given. (M.C.G.)

16188 (NYO-7884) INSTRUCTIONS AND INFORMATION RELATING TO FORCE AND PRESSURE CALCULATIONS, TABLES, AND GRAPHS PERTAINING TO AN INDUCTIVE ENERGY STORAGE DEVICE. Technical Memorandum No. 41. A. L. Lind (Princeton Univ., N. J. Project Matterhorn). Jan. 2, 1957. Decl. Jan. 25, 1957. 27p.

Total force and pressure measurements for a circular coil of square cross section were performed, based on "Five Per Cent Resistance Analog," and are presented in graphic and tabular form. The pressure distribution was resolved into radial and axial components. Both electromagnetic and mechanical forces are considered. (D.L.C.)

16189 (OOR-2271:3) MAGNETIC FIELDS AND NUCLEAR MAGNETIC MOMENTS. Final Report. Max Caspari and Sherman Frankel (Office of Ordnance Research, [Durham, N. C.]). Feb. 1961. Contract DA-36-034-ORD-2787. 6p.

Hyperfine interactions and nuclear magnetic moments of short-lived excited states were determined for the rare earth ion in polycrystalline samples of various rare earth iron garnets. The experiments were carried out as a function of temperature to 1000°C, the perturbation of the angular correlation due to the hyperfine interaction in the intermediate state of a $\gamma-\gamma$ cascade following β decay or K capture processes. Investigations were made of the 1415- to 122-kev $\gamma-\gamma$ angular correlation in Sm^{152}, the 1100- to 120-kev $\gamma-\gamma$ correlation in Gd^{154}, and the 879- and 962- to 87-kev $\gamma-\gamma$ correlation in Dy^{160}. In each case the intermediate state was the 2+ rotational state with a lifetime of the order of 10^{-9} sec. The electron spin relaxation times were also determined and their effects on the angular correlation investigated. (M.C.G.)

16190 (ORNL-3031) THE HIGH SPECIFIC IMPULSE, ARC-ION SYSTEM. J. S. Luce and J. W. Flowers (Oak Ridge National Lab., Tenn.). Apr. 21, 1961. Contract W-7405-eng-26. 47p.

The use of high exhaust velocity in a space vehicle after gravitational forces are overcome is made necessary by the large mass loss inherent with high-thrust low-specific-impulse devices needed for takeoff. Increased maneuverability, greater range and larger payloads are obvious advantages which accrue from the development of a successful high specific impulse system. A little-explored but promising high specific impulse method was considered: the arc-ion system. The ion source used with this system utilizes an arc for ionization of the propellant and the resultant ions are accelerated electrostatically. The arc system of ionization is adaptable to advanced methods of space-charge neutralization because the arc is transparent to high-energy electrons which can be passed through it. These electrons reduce the positive ion space potential in the accelerating gap and drift spaces. The achievement of space-charge neutrality in these systems would, in principle, allow beams of very large density to be accelerated. Child's Law sets definite limits to the obtainable current in space charge limited sources. The arc-ion system, however, lends itself naturally to development of new space charge neutralization techniques. If successful neutralization is achieved the system will cover the same specific impulse range as the arc jet, plasma, and ion propulsion methods with one simple device. Obviously, the recognized ability of ion propulsion to achieve high specific impulse should be enhanced by the laboratory-proven advantages of the arc-ion system. Any ion species can be accelerated and controlled in the arc-ion system. Large ion emission areas and ion beams in the multi-ampere range were achieved with arc-type ion sources. The arc-ion system, and certain plasma systems, allow the use of "pumping propellants," such as Ti, Zr, U, and many others, which because of their low vapor pressure at normal temperature permit the construction of low-cost, high-capacity ground testing facilities. The flexibility and extensive potentialities of the arc-ion system were found to justify a program at least comparable in magnitude to cesium contact source. (auth)

16191 (PIBMRI-821-60) DIFFRACTION BY A CYLINDER WITH A VARIABLE SURFACE IMPEDANCE. Chester J. Marcinkowski and Leopold B. Felsen (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Jan. 27, 1961. Contract AF19(604)-4143. 108p. (AFCRL-88).

A solution is obtained for the two-dimensional electromagnetic problem of diffraction of the radiation from a magnetic or electric line current source by a cylinder with a spatially varying surface impedance. The surface impedance has a sinusoidal variation of small amplitude around the periphery of the cylinder superimposed upon an arbitrary, constant value. A Green's function formulation reduces the problem to an inhomogeneous, second-order difference equation with variable coefficients which is solved by a perturbation procedure in terms of the small amplitude α of the impedance variation. For plane wave incidence, the asymptotic form of the solution for a large cylinder ($ka \gg 1$) is investigated in detail to first order in the perturbation parameter α. A saddle point evaluation in the illuminated region yields a result which can be interpreted in terms of the geometrical optics appropriate to a cylindrically curved, convex reflection grating. The solution comprises the first' and higher' order reflected rays familiar from a plane grating, modified by appropriate geometrical divergence coefficients. For a slowly varying surface impedance, conditions are derived under which the various reflected rays in the solution to $O(\alpha)$ may be combined into a single, specularly reflected ray with a reflection coefficient depending only on the local impedance value at the point of reflection. (auth)

16192 (R61SD004) HIGH TEMPERATURE SPECTRAL EMISSIVITY STUDIES. Thomas R. Riethof (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). Jan. 1961. 34p.

Presented at the conference on Radiative Transfer from Solid Materials, Boston, Mass., December 12-13, 1960.

The techniques used to measure normal spectral emissivities of opaque solids at high temperatures and their relative merits in light of experimental difficulties are discussed. Some recent emissivity results are presented and compared with literature values for the following: (1) measured with image furnace: tungsten, molybdenum, and nickel, and (2) measured with induction furnace: tungsten, tantalum carbide, tantalum, zirconium carbide, and siliconized ATJ graphite. In addition, literature data are presented for rhenium and silicon carbide. (D.L.C.)

16193 (SB-447) FUEL CELLS AND RELATED RESEARCH. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Feb. 1961. 7p.

The titles of 82 reports dealing with fuel cells and related research leading to the development of fuel cells are given. Reports on subjects in the general fields of batteries, electrical power sources, and electrochemistry were included because they contain some information on fuel cell research. (auth)

16194 (SCR-263) THEORIES AND APPLICATIONS OF VERY LOW TEMPERATURES. Nicholas Kurti (Oxford Univ.). Jan. 1961. 20p.

Sandia Corporation Research Colloquium.

The problem of producing very low temperatures (down to 3×10^{-3}°K) is discussed with respect to an entropy vs temperature graph. Two conditions are given for production of low temperatures: (1) A finite entropy must be present and a reduction in entropy must be possible. (2) The heat capacity must be low. The lowest temperature attainable with liquified gases is only a few tenths of 1°K, but certain paramagnetic salts used in conjunction with magnetic fields make further temperature lowerings possible, particularly those salts whose magnetism is due to nuclear rather than electron spin. Some of the difficulties involved in attaining temperature lowerings with those salts are treated in detail. (D.L.C.)

16195 (SCTM-97-56(51)) GRAPHICAL PRESENTATION FOR DETERMINATION OF THE TERMINAL VELOCITY OF ROTOCHUTE- AND PARACHUTE-RETARDED AERODYNAMIC BODIES. Helen M. Tolmie (Sandia Corp., Albuquerque, N. Mex.). May 25, 1956. 6p.

Equations are presented for calculating terminal velocity of a parachute- or rotochute-retarded vehicle. Curves are included to facilitate estimating terminal velocities at various altitudes. (auth)

16196 (TID-3561) DIRECT ENERGY CONVERSION DEVICES. A Literature Search. Henry D. Raleigh, comp. (Office of Technical Information Extension, AEC). Mar. 1961. 25p.

A bibliography comprising 208 unclassified references is presented on nuclear direct energy conversion devices. Major emphasis is placed on auxiliary power devices suitable for use in satellites including reports on nuclear batteries, thermoelectric cells, thermionic conversion and aspects of the SNAP program. (J.R.D.)

16197 (TID-12493) CALCULATIONS OF THE COEFFICIENT OF VISCOSITY AND THE COEFFICIENTS OF DIFFUSION FOR DISSOCIATING HYDROGEN. D. G. Clifton (Los Alamos Scientific Lab., N. Mex.). [1960?]. 13p.

The kinetic theory of dilute monatomic gases and mixtures was used to calculate some transport properties of dissociated hydrogen. The H_2-H_2 and H-H_2 interactions were assumed to obey the modified Buckingham (exp-6) potential and the Lennard-Jones (12-6) potential, respectively. The two H-H interaction potentials ($^1\Sigma_g$ and $^3\Sigma_u$) were treated by the method of Hirschfelder and Eliason to obtain a weighted average rigid-sphere collision diameter. The coefficient of viscosity, the coefficient of diffusion in a binary mixture of the H-H_2 system, and the coefficients of self-diffusion for H atoms and H_2 molecules were computed for temperatures from 1500 to 5000°K and pressures of 0.1, 0.5, 1, 2, 10, 50, and 100 atmospheres. (auth)

16198 (UCRL-9318) LECTURES ON SUPERCONDUCTIVITY BY ANDREW M. SESSLER AT THE UNIVERSITY OF CALIFORNIA DURING THE SPRING SEMESTER, 1960. Notes by John M. Cornwall (California. Univ., Berkeley. Lawrence Radiation Lab.). June 1960. Contract W-7405-eng-48. 42p.

Experimental facts and a discussion of the Bardeen, Cooper, and Schrieffer theory are presented in a treatment of superconductivity. The thermodynamics and electromagnetic properties of superconductors are also discussed. The early theories of superconductivity and the concept of Cooper pairs are reviewed. The analysis worked out by Bogoluibor involving interactions between all particles is outlined. The existence of the Meissner effect is established. (M.C.G.)

16199 (AWRE/Trans-12) INITIATION PROCESSES IN LIQUID EXPLOSIVES. M. Zippermayr. Translated by J. R. T. Lloyd from Chimia (Switz.), 13: 56-63(Feb. 1959). 19p.

In the initiation of liquid explosives, shock processes are of outstanding importance. Tests showed that only impacts of an elastic kind are able to set up decomposition reactions and under optimum conditions even minimum impact energies suffice. The pressure to which the explosive liquid is subjected at the instant of initiation favors, to a limited extent, the onset of detonation. If the shock occurs in strongly damping conditions, i.e., inelastic, then even large shock energies are ineffective because initiating shocks cannot be produced in the liquid explosive subjected to inelastic impact. In view of the results, "thermal initiation" can be regarded as an excitation process accompanied by high damping. A single and definite temperature jump will indeed invariably lead to equilibrium with the surroundings, but it does not give rise to a periodically fluctuating temperature. This provides an explanation for the fact that molecular excitation from mechanical means is much more effective than thermal excitation. The apparently widely varying and inconsistent behavior of liquid explosives under various stresses is mainly from circumstances, not always obvious or predictable, in which the shock imparted may prove to be of an elastic nature. An instructive demonstration of the validity of the conclusions is afforded by the fact that the detonation is invariably brought about by small gas bubbles compressed upon impact or by a tiny aluminum pellet projected at a velocity of 500 to 600 m/sec, whereas a steel ball fired at speeds of up to 1100 m/sec and liquid iron dripped into the DNB-NA solution both fail to ignite it. Experiments show that initiation by elastic shock takes place in the expansion phase and not in the compression phase. An attempt was made to formulate a satisfactory idea of the nature of the process initiating the explosive reaction. (auth)

16200 (SCL-T-361) ON THE CHARGING OF "ELECTRETS." Kurt Palm. Translated by Marcel I. Weinreich from Exptl. Tech. Physik, 4: 253-62(1956). 13p.

During the formation of electrets made of high polymers, three types of charges occur. Depending on the choice of the substances and the fixation of the reactive field intensities, there are frozen pure countercharges, pure equal charges, or both in coexistence. The time function of the electret charge and the charge distribution over the dielectric surface are dependent on the type of charge. (auth)

16201 (UCRL-Trans-634(L)) ON THE IONIZATION OF ALKALI ATOMS BY SLOW ELECTRONS. Hans Funk. Translated by Forrest Baker from Ann. Physik, 4: 149-84 (1930). 43p.

An investigation was conducted to design an arrangement for impacting slow electrons on atomic beams. Such an arrangement would allow the order of magnitude estimation of measurable effects, and would provide for determination of excitation and ionization yields. Potassium and sodium were selected for investigation. The yield, obtained as the ratio of the sum of ionization cross-sections to the sum of kinetic cross sections, for potassium was about 20% com-

ared with maximum theoretical of 54%. Sodium yielded ... compared with 50% theoretical. The numerical values ... ionization cross sections were 29 cm^2/cm^3 for sodium ... 11 cm^2/cm^3 for potassium. (J.R.D.)

16202 THE DISTRIBUTION OF ELECTRONS IN THE PROCESS OF IMPACT IONIZATION. Maria Miasek (Univ. of Warsaw). Acta Phys. Polon., 20: 43-58(1961). (In English)

The probability function is calculated for occupation of definite energy levels in the conduction band of an insulator or semiconductor following an electron impact ionization event. A finite width is assumed for the valence band. Several situations are examined, with varying primary electron energies and effective valence band masses. (auth)

16203 THE THERMODYNAMICS OF PHASE EQUILIBRIUM. Laszlo Tisza (Massachusetts Inst. of Tech., Cambridge). Ann. Phys. (N. Y.), 13: 1-92(Apr. 1961).

The Gibbstan thermodynamics of phase equilibrium is distinguished from the thermodynamics of Clausius and Kelvin. The analysis of the basic assumptions of the Gibbs theory allows the identification and removal of defects that marred the classical formulation. (N.W.R.)

16204 THE SURFACE OF THE WAVE IN MAGNETOHYDRODYNAMICS. [PART] I. Cataldo Agostinelli. Atti acad. nazl. Lincei. Rend., Classe sci. fis., mat. e nat., 28: 746-50(June 1960). (In Italian)

The differential equation of the wave surface of a compressible fluid of infinite electrical conductivity was established using the homographic vector method and the Alfven hypothesis that the displacement current can be neglected with respect to the conduction current. (J.S.R.)

16205 SECONDARY ELECTRON EMISSION FROM COPPER–BERYLLIUM (4%) SURFACE BY BOMBARDMENT OF VARIOUS POSITIVE IONS. Toshio Sugiura and Teruo Hayakawa (Osaka Prefectural Univ., Univ. of Osaka Prefecture, Sakai, Japan). Bull. Chem. Soc. Japan, 34: 58-63(Jan. 1961). (In English)

The secondary electron emission from the non-activated and activated surfaces of copper-beryllium (4%) by the impacts of various noble gas and hydrocarbon ions was studied, and the surface structure was determined by electron diffraction analysis. The main results obtained are as follows: A thick layer of beryllium oxide is formed in the neighborhood of the target surface activated by oxygen at 350 to 480°C. Oxide films of copper are formed on the target surface by electropolishing, but these oxides are easily reduced by prolonged ion bombardment. The optimum temperature for electron yield activation seems to be about 420°C, and the electron yield for the activated target surface treated at 350 or 420°C is only slightly dependent upon the ion kinetic energy. No measurable decrease in the electron yield for an activated surface treated at 420°C was obtained by prolonged bombardments with various positive ions, while the electron yield for the non-activated surface decreases about 20% in prolonged bombardments. Under the experimental conditions used, the mechanism of electron ejection seems to be considerably complicated, and it is difficult to deduce any definite conclusion for the electron ejection process. (auth)

16206 THEORETICAL ASPECTS OF PHENOMENA OF IONIZATION AND MOLECULAR DISSOCIATION UNDER ELECTRON BOMBARDMENT. L. D'Or, J. C. Lorquet, and J. Momigny (Université, Liège). Bull classe sci., Acad. roy. Belg. (5), 46: 650-62(1960). (In French)

A preliminary report of a new nonstatistical theory of the mass spectra is presented. The treatment includes the discussion of two points: position of the electronic levels of the ion with a discussion of the dissociation characteristics of each of these levels and study of the transition probabilities to these levels. The mass spectrum of small molecules (N_2, O_2, NO, CO, CO_2, and H_2O) is calculated and compared with available experimental data. The same procedure is applied to 1,3-butadiene, using this time theoretical estimates of its electronic levels. (auth)

16207 A POLONIUM–BERYLLIUM SOURCE OF NEUTRONS. O. D. Belomar. Byull. Izobretenii, No. 8, 35 (1960).

To obtain a stream of neutrons of variable intensity, and cut off the stream when the source is in an inactive state, the source is made in the form of two systems of plates placed in a vacuum-sealed body. The first system is fixed and is composed of plates bearing on their surfaces polonium or its stable compound, while the second system is mobile and contains plates coated with beryllium or its compound which pass between the plates in the first system in the work position. The second system is subjected on one side to the action of a spring and on the other to the forces of a magnetic field created by an electromagnet or a magnet. (auth)

16208 DIRECT TRANSFORMATION OF THERMAL ENERGY INTO ELECTRIC ENERGY BY MEANS OF THERMAL EMISSION. E. Tomkova (Charles Univ., Prague). Československ. časopis pro fysiku, No. 5, 430(1960).

Several diode systems employing either directly heated tungsten cathodes (the collector being in the form of molybdenum cylinders of various diameters) or a flat or cylindrical impregnated cathode were measured. The negative space charge of electrons was compensated by positive cesium ions produced by the thermal emission at the cathode. The effect of the presence of a metallic polonium deposited on a molybdenum base on the efficiency of the diodes was investigated. (auth)

16209 FREEZING-IN OF HOLES IN SILVER. Yves Quere (Centre d'Etudes Nucleaires, Saclay, France). Compt. rend., 251: 367-9(July 18, 1960). (CEA-1711). (In French)

The holes which are in equilibrium in a metal at high temperature may be retained by freezing in. By measuring at low temperature the increase in resistivity $\Delta\rho$ produced by these frozen holes, the following equation is verified in the case of Ag: $\Delta\rho = \Delta\rho_0 \exp(-E_f/kT)$, where T is the absolute temperature of the metal before freezing. The energy of formation of the holes is then determined: $E_f = (1.06 \pm 0.07)$ ev, $\Delta\rho_0 = (4.9 \pm 1.5) \times 10^{-4}$ Ω/cm. (auth)

16210 CALCULATION OF THE ELASTIC SCATTERING OF A SLOW ELECTRON BY AN ATOM OF NEUTRAL SODIUM IN THE GROUND STATE. Albert Salmona. (Institut Henri Poincaré, Paris). Compt. rend., 252: 997-8(Feb. 13, 1961). (In French)

The problem of shock in the elastic scattering of a slow electron by a neutral sodium atom is treated. The effects of polarization and of exchange are considered. (tr-auth)

16211 TRANSITION BETWEEN THE REGIME OF LUMINESCENCE AND THE ARC REGIME. Yvonne Leycuras (C.N.R.S., Bellevue, Seine-et-Oise, France). Compt. rend., 252: 1005-7(Feb. 13, 1961). (In French)

Discharges under atmospheric pressure in direct and alternating current were studied. The luminescence regime is a relaxation regime, each of the oscillations, called primary discharge, were oscillating. The relaxation is connected to the oscillation in the primary discharge. When the oscillation is damped, the relaxation disappears and the discharge becomes an arc. (tr-auth)

16212 EXPERIMENTAL DETERMINATION OF THE DYNAMIC ADIABATICS OF A NON-REACTING EXPLOSIVE. Claude Fauquignon (Commissariat a l'Energie Atomique, [Paris]). Compt. rend., 252: 1116-18(Feb. 20, 1961). (In French)

An experimental method for the determination of the dynamic adiabatics of a non-reacting explosive is described. The results are applied in calculating the pressure in the front of a stable detonation wave. (tr-auth)

16213 DETERMINATION OF THE INSTANT OF EMISSION OF A PHOTON OF THE VISIBLE RANGE WITH A PRECISION BELOW 3×10^{-10} SEC. Bernard Agrinier and Alain Raviart. Compt. rend., 252: 1127-8(Feb. 20, 1961). (In French)

The delay fluctuations caused by a photomultiplier tube in measuring the instant of luminous photon emission were determined. The results obtained prove that with the fast photomultipliers of recent development, type 56 AVP, the instant of emission can be determined with a precision of $3\ (\pm 1) \times 10^{-10}$ sec. The apparatus used permits a study of the effect of the photomultiplier electrodes on the fluctuations of transit time in the tube. (tr-auth)

16214 THE M EMISSION SPECTRUM OF X RAYS OF PLUTONIUM. Jean-Louis Bobin and Jean Despres. Compt. rend., 252: 1302-4(Feb. 27, 1961). (In French)

By means of a Castaing microanalyzer, a large part of the M emission spectrum of plutonium was examined. The experimental results have shown evidence of satellite groups accompanying the more intense rays. (tr-auth)

16215 THE SPECIFIC HEAT OF THE HYPERFINE STRUCTURE OF SAMARIUM. Bernard Dreyfus, Bruce Bailey Goodman, Gilbert Trolliet, and Louis Weil (Université, Grenoble, France). Compt. rend., 252: 1743-5 (Mar. 20, 1961). (In French)

Below 1°K the specific heat of samarium shows a strong contribution caused by the hyperfine magnetic coupling, of the form AT^{-2}. The experimental value of A, 11 ± 2 mJ/mole degree, which corresponds to an effective field acting on the nuclei of $3.8 \pm 0.4 \times 10^6$ gauss, suggests that at low temperatures the Sm^{3+} ion is found in the state $M_z = \pm 5/2$. (tr-auth)

16216 PLANE WAVE MOTION OF AN INCOMPRESSIBLE CONDUCTING FLUID WITH ALLOWANCE FOR ELECTROMAGNETIC RADIATION. A. E. Yakubenko (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 136: 1310-12(Feb. 21, 1961). (In Russian)

The oscillations of a finite plane layer of incompressible, conducting fluid are analyzed. The oscillations are the result of energy and pressure developed on the free surface as a result of the outer magnetic field and the external medium. The electromagnetic emission induced by the oscillations carries away the energy and eventually stops the motion. The problem is resolved by Lagrange variables. (R.V.J.)

16217 REALIZATION OF VARIED TARGETS INCORPORATED IN NUCLEAR EMULSIONS. Madeleine Avan (Faculte des Sciences, Clermont-Ferrand, France). Inds. atomiques, 4: Nos. 11/12, 61-9(1960). (In French)

The practical realization of targets incorporated in nuclear emulsions requires the elimination of various difficulties: pseudophotographic actions of metals, local distortions in the vicinity of the targets, slight generalized deformations of the sensitive layer, and study of a method of appropriate development. The methods of incorporation of wires or powders are described. The first results obtained with the scattering of mesons by a silver wire incorporated in the emulsion are given to illustrate the method. (J.S.R.)

16218 THE ION SOURCES WITH HIGH FREQUENCY ELECTRIC EXCITATION. Daniel Blanc (Universite, Toulouse, France) and André Degeilh. Inds. atomiques, 4: Nos. 11/12, 71-7(1960). (In French)

The use of particle accelerators necessitates very intense beams of positive ions. The sources with high-frequency electric excitation are often used. The published data on these sources are reviewed. The mode of operation (discharge structure, beam extraction, and parameters modifying the intensity of the beam extracted) is defined, and models of sources are described. The region of application of HF sources is then tabulated. (tr-auth)

16219 FOLDED DIPOLES AND LOOPS. C. W. Harrison, Jr. and R. W. P. King (Sandia Corp., N. Mex.). IRE Trans. on Antennas and Propagation, AP-9: No. 2, 171-87 (Mar. 1961). (SCR-210)

The theory of linear arrays consisting of two or more closely spaced elements interconnected by lumped reactances is reviewed. Specific application is made to two-element end-loaded folded dipoles and monopoles constructed of conductors with different diameters, to series tuned three-wire folded dipoles and monopoles, and to a three-wire-line reactor and impedance transformer. The circular folded dipole or Halo antenna is also treated. (auth)

16220 CATHODE-LUMINESCENCE OF EUROPIUM ACTIVATED STRONTIUM PHOSPHATES. V. P. Nazarova. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 332-5(Mar. 1961). (In Russian)

The cathode luminescence of Eu-activated strontium phosphates was investigated in an effort to find new cathode-luminophors with blue light and fast damping. $Sr_3(PO_4)_2$-Eu proved to be the brightest with an intensity of 25 to 35% of the ZnS-Ag intensity; all Eu-activated strontium phosphates are fast damping ($>10^{-4}$ sec). (R.V.J.)

16221 KINETICS OF ZnS-Cu LUMINESCENCE ACTIVATED BY α PARTICLES AND SHORT LIGHT PULSES. T. P. Belikova and M. D. Galanin. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 364-6(Mar. 1961). (In Russian)

Comparisons were made of α-scintillation and photoluminescence kinetics using the blue and green bands of ZnS-Cu. Neither α-scintillation nor photoluminescence were influenced by temperature in the range -150 to 200°C. With α-damping up to 10% of the maximum intensity, light de-excitation is about 5% for ZnS-Cu. (R.V.J.)

16222 INVESTIGATION OF ZnS PHOSPHORS DOUBLY ACTIVATED BY SILVER AND SAMARIUM. V. L. Levshin, Yu. V. Voronov, V. B. Gutan, S. A. Fridman, and V. V. Shchaenko (Lebedev Inst. of Physics, Moscow). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 25: 392-9(Mar. 1961). (In Russian)

Phosphors activated only by silver and only by samarium and phosphors containing up to 10^{-4} g/g of Ag and 10^{-7} to 10^{-3} g/g of Sm were studied. (R.V.J.)

16223 SCALING LAWS FOR ELECTRIC ARCS SUBJECT TO FORCED CONVECTION. Christopher Sherman and J. M. Yos (AVCO Research and Development, Wilmington, Mass.). J. Appl. Phys., 32: 744(Apr. 1961).

The positive column voltage (ϕ) of an arc is investigated under conditions of cylindrical geometry and forced convection of Ar or N gas. An expression for ϕ is found as a function of properties of the gas and the geometry. It is shown that if the electrode length and the total arc current are multiplied by an arbitrary factor α, and the mass flow/

nit area and the pressure are multiplied by $1/\alpha$, ϕ is invariant. This ϕ invariance scaling law is studied experimentally. (T.F.H.)

16224 ANALYSIS OF THE ABSORPTION SPECTRUM AND ZEEMAN EFFECT OF THULIUM ETHYLSULPHATE. Eugene Y. Wong and Isaac Richman (Univ. of California, Los Angeles). J. Chem. Phys., 34: 1182-5(Apr. 1961).

The crystalline field interaction was calculated using first-order perturbation theory on intermediate coupling wave functions of Tm^{3+} in a D_{3h} field. Good agreement with experimental data of Tm^{3+} diluted with $La(C_2H_5SO_4)_3 \cdot 9H_2O$ was obtained. The following crystalline field parameters were chosen for best fit: $A_2^0(r^2) = 129.8\ cm^{-1}$, $A_4^0(r^4) = -71.0\ cm^{-1}$, $A_6^0(r^6) = -28.6\ cm^{-1}$, $A_6^6(r^6) = 432.8\ cm^{-1}$. (auth)

16225 IONIZATION POTENTIALS OF MULTIPLY CHARGED KRYPTON, XENON, AND MERCURY. F. H. Dorman and J. D. Morrison (Commonwealth Scientific and Industrial Research Organization, Melbourne). J. Chem. Phys., 34: 1407-10(Apr. 1961).

The determination of threshold potentials for multiple ionization processes is shown to depend on the threshold law assumed for these processes. Further support is obtained for the previously proposed nth power rule for n-fold ionization by electron impact, and limits are set to the values of the thresholds for multiple ionization in the rare gases and mercury. (auth)

16226 ANALYSIS OF FAST WAVE COUPLERS FOR TRANSVERSE FIELD BEAM TYPE PARAMETRIC AMPLIFIERS. N. B. Chakraborty (Univ. of Calcutta). J. Electronics and Control (1), 10: 147-51(Feb. 1961).

A traveling-wave coupler for fast wave excitation only of a transverse field parameter beam amplifier is analyzed. The analysis indicates that, as expected, "a dip condition" for a transverse field tube can be achieved, insuring almost complete transfer of the fast wave beam noise to the circuit and of the circuit signal power to the fast beam wave. This requires that the slow and fast beam waves be sufficiently separated in velocity (i.e., the cyclotron frequency be high enough), that the circuit wave be in close synchronism with the fast beam wave, and that the coupling between the circuit and the beam be loose. (auth)

16227 ELECTRON DIFFRACTION EXAMINATION OF SINGLE CRYSTAL LAYERS IN URANIUM OXIDES IN THE REGION UO_2 TO U_4O_9. S. Steeb (Max-Planck-Institut für Metallforschung, Stuttgart). J. Nuclear Materials, 3: 235-6(Feb. 1961). (In German)

An oxide preparation of O/U between 2.04 and 1.96 was heated in an electron diffractograph to 250 to 500°C, and O_2 at 10^{-3} Torr let in. After only a few minutes, numerous new points appeared in the basic matrix, the lattice constant of which had diminished only slightly to 5.43 A, corresponding to the compound U_4O_9. The "overstructure points" are arranged on a quadratic network whose edge length compares to the original as 1:8, that is, in the pertinent crystal lattice there are overstructure cells with an edge length of 8 times 5.43 or 43.44A. When the O_2 is removed the points disappear, and they reappear when the O_2 is replaced. The critical temperature is 580°C for 10^{-3} Torr O_2 and 415°C for 10^{-4} Torr O_2. (T.R.H.)

16228 STATISTICAL QUANTUM MECHANICS. DENSITY OPERATORS AND THERMODYNAMIC VALUES. J. Yvon (Centre d'Etudes Nucléaires, Saclay, France). J. phys. radium, 21: 569-74(July 1960). (CEA-1824). (In French)

The simple and double density operators, as functions of temperature and activity, are computed for a system in equilibrium. The scattering operator allows, in some cases, separating the thermodynamic variables. In particular, these variables do not appear in the expression of the double density operator, as a function of the simple density operator; which explains the fact that this expression is still valid out of equilibrium. (auth)

16229 INVESTIGATION OF THE LUMINESCENCE CAPABILITY OF ANTHRACENE-POLYSTYROL SCINTILLATORS IN DEPENDENCE ON THE PREPARATION CONDITIONS. J. Kunze and E. Rexer. Kernenergie, 3: 1169-71(Dec. 1960). (In German)

Organic scintillators with polystyrol base and anthracene additions have been reported in which the purity of the initial materials, the polymerization temperature, and the polymerization species were varied during their preparation. Whereas in organic crystals the highest purity leads to the highest yield, the luminescence capabilities in solid organic solutions is not changed when the mass of organic impurities ranges between ≈1 and 10^{-1}% in the monostyrol and between 1 and 10^{-2}% in anthracene. Small masses of water or oxygen reduce the luminescence yield. In contrast with values obtained in samples polymerized with 0.5% benzoyl peroxide as catalyst, the luminescence yield of pure thermal polymerizate amounts to only 80 to 90%. By the action of γ rays, polymerized samples gave light yields of only 20% of the yield of the best thermal polymerizates. The luminescence capability of the scintillators is dependent on the polymerization temperature. The best light yield for a given anthracene concentration and the polymerization time used was obtained at a polymerization temperature of 140 to 150°C. (tr-auth)

16230 AN EVAPORATION APPARATUS FOR SOURCE PREPARATION FOR β SPECTROSCOPY. R. Hoffmann and H. Kaiser (Deutsche Akademie der Wissenschaften, Berlin). Kernenergie, 4: 12-14(Jan. 1961). (In German)

An evaporation apparatus with portable collector and graphite oven with beam focusing is described. It was used for the preparation of homogeneous circular and point radioactive sources. The homogeneity was determined autoradiographically. The source thickness is reproducible within the limits necessary for utilization in a β spectrometer. The effect of the source thickness on the shift of conversion lines was investigated with a $\pi\sqrt{2}$ spectrometer. (tr-auth)

16231 LUMINESCENCE EXCITATION WITH TRITIUM BETA RADIATION. H. Heusinger (Technische Hochschule, Munich). Kerntechnik, 3: 67-70(Feb. 1961). (In German)

It was shown that the substitution of β radiators for α radiators, especially the substitution of tritium, offers many advantages. The suitability of tritium for introduction in luminous materials is discussed with respect to its half life and range. It is shown that the layer thickness is of decisive importance for the energy yield/curie curve. The possibility of introducing tritium into luminescent materials is discussed, and methods for the introduction of tritium into luminescent base paints are given. Investigations on the introduction of tritium in the form of hydroxides into phosphors are reported. Luminescent yields of these phosphors are compared with each other and with a radium sample. (tr-auth)

16232 DISCRIMINATION BETWEEN α-TRACKS AND γ-BACKGROUND IN ILFORD NUCLEAR EMULSIONS. K. Van Camp, M. Dorikens, and L. Dorikens-Vanpraet (Univ. of Ghent). Nature, 190: 38-9(Apr. 1, 1961).

A procedure is described for improving the discrimination between α tracks and γ background in Ilford 50μ nu-

clear emulsions by utilizing the Herschel effect. Aqueous solutions of phenosafranine were used as a desensitizer before exposure to infrared irradiation. (C.H.)

16233 EFFECT OF RADIOFREQUENCY RESONANCE ON THE NATURAL LINE FORM. M. N. Hack and M. Hamermesh (Argonne National Lab., Ill.). Nuovo cimento (10), 19: 546-57(Feb. 1, 1961). (In English)

The form of Zeeman lines in the presence of a resonant rotating r-f magnetic field is determined. The spontaneous emission distributions are obtained from the steady-state solutions, leading to a prediction of the splitting of Zeeman lines at rotation frequencies corresponding to well separated single- and multiple-quantum resonance frequencies, as well as at the resonance frequency in the Majorana case. (auth)

16234 PROPAGATION OF ELECTROMAGNETIC WAVES IN A PLASMA WITH STRONG MAGNETIC FIELD. H. Poeverlein (Air Force Cambridge Research Labs., Bedford, Mass.). Phys. Fluids, 4: 397-405(Apr. 1961).

Formulations describing the propagation of electromagnetic waves in a cold plasma in the presence of a constant magnetic field H_0 become particularly simple in a limit case that corresponds to a high longitudinal conductivity component (component parallel to H_0) and negligible transverse conductivity components. In this case, perfect guidance along the magnetic force lines is found for one propagation mode and propagation independent of direction for the other, characteristics known to appear in hydromagnetic waves. In the present case, however, no ion effects need be taken into consideration and the phase velocity is high, equaling vacuum velocity. Propagation of plane waves is treated and a wave-theoretical formulation is derived, valid for any wave field under the assumed conditions with a uniform magnetic field. A section on propagation in force line tubes includes some physical discussion. Comparisons are made between our limit case and other limit cases of waves in plasmas, which have been thoroughly studied previously—hydromagnetic waves (without compressional forces) and ionospheric whistlers. (auth)

16235 TWO-REACTION STEADY DETONATIONS. Jerome J. Erpenbeck (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 4: 481-92(Apr. 1961).

Steady, one-dimensional detonations in an idealized, three-component, gaseous medium with reactions $A \rightleftharpoons B$, $A \rightleftharpoons C$, proceeding with Arrhenius unimolecular kinetics are investigated by way of exemplification of the Wood-Salsburg analysis as well as delineation of the behavior at the troublesome "pathological" locus for this special case. The analysis is detailed for the exothermic parallel-reaction case with large disparity in the heats of reaction but results for other cases are mentioned. Stability conditions for a pathological detonation are reformulated as conditions on the parameters of the system which, though necessary, are by no means sufficient. For both the exothermic parallel-reaction case and the consecutive-reaction case, with the second reaction endothermic, it appears that the stability conditions are not inconsistent with the existence of a pathological solution. Numerical results for several systems at the equilibrium Chapman-Jouguet detonation velocity are presented, including one in which the equilibrium CJ condition is inapplicable. (auth)

16236 SHOCK INITIATION OF DETONATION IN LIQUID EXPLOSIVES. A. W. Campbell, W. C. Davis, and J. R. Travis (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 4: 498-510(Apr. 1961).

Experimental studies of the initiation of liquid explosives by strong plane shocks (pressures 50 to 100 kbar) are described. These experiments demonstrate thermal explosion as a result of shock heating in the explosive. When the shock enters the explosive, the explosive is heated. After a delay, detonation in the heated, compressed explosive begins at the interface, where the explosive has been hot longest. The detonation proceeds through the compressed explosive at a velocity greater than the steady state velocity in uncompressed explosive, overtaking the initial shock and overdriving detonation in the unshocked explosive. Most of the work was done on nitromethane, but molten TNT, molten DINA, Dithekite 13, and single crystals of PETN are shown to behave in the same way. Experiments showing the effects of bubbles and shock interactions in the explosive are presented. (auth)

16237 SHOCK INITIATION OF SOLID EXPLOSIVES. A. W. Campbell, W. C. Davis, J. B. Ramsay, and F. R. Travis (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 4: 511-21(Apr. 1961).

Initiation phenomena in solid explosives produced by strong shock waves are described. Shock pressures in the explosive are between 20 and 200 kbar. It is demonstrated that in the usual case the shock wave travels not as an inert shock, but as a shock to which the explosive contributes energy, probably from reaction at voids and defects. This slightly reacting shock travels at increasing velocity for some distance, typically 1 cm in the experiments described, and then in a travel of perhaps 0.01 cm becomes full detonation, moving at full velocity. The increase to full detonation velocity occurs without overshoot. Experiments demonstrating the variation of sensitivity to shock with density, grain size, and other properties are discussed. The explosives studied are cyclotol B, TNT, plastic-bonded HMX, and nitromethane-carborundum mixtures. (auth)

16238 DYNAMICS OF ATOMIC MOTIONS IN LIQUIDS AND COLD NEUTRON SCATTERING. A. Rahman, K. S. Singwi, and A. Sjölander (Argonne National Lab., Ill.). Phys. Rev., 122: 9-12(Apr. 1, 1961).

The self-correlation function for the motion of an atom in a liquid was constructed in a manner which simulates the behavior of this function between the two extreme cases, viz., that in a solid and that in a simple diffusive model. Using this function, the differential scattering cross section for cold neutrons was calculated for liquid lead and compared with available experimental results. It appears that even in a simple liquid like lead the solidlike behavior of atomic motions persists for a considerable time. (auth)

16239 ABSOLUTE MEASUREMENT OF THE ATOMIC SCATTERING FACTORS OF IRON, COPPER, AND ALUMINUM. Boris W. Batterman (Bell Telephone Labs., Murray Hill, N. J.), David R. Chipman, and John J. DeMarco. Phys. Rev., 122: 68-74(Apr. 1, 1961).

The x-ray atomic scattering factors of iron, copper, and aluminum were carefully remeasured to obtain more reliable information on the outer electron charge densities in these elements. The scattering factors were obtained from measurements of the integrated Bragg intensities of powder samples using monochromatic Mo K_α radiation. The intensities were put on an absolute scale by direct measurements of the power in the primary x-ray beam. Extinction, surface roughness, and preferred orientation effects were shown to be negligible in the samples used. The ratios of the measured scattering factors of the three elements agree with those calculated from Hartree-Fock theory to within 1%. This substantiates the findings of Batterman, and, in contrast with the previous results of Weiss and

DeMarco, indicates that there is no large discrepancy between the electronic structures of copper and iron. The absolute values of the measured scattering factors, however, lie about 4% below theory in the region of low sin θ/λ. It is pointed out that the high theoretical values for iron and copper could result from known differences in electronic structure between a free atom and one in the solid, but that present theory probably cannot account for the discrepancy in the case of aluminum. (auth)

16240 THEORY OF AUGER NEUTRALIZATION OF IONS AT THE SURFACE OF A DIAMOND-TYPE SEMICONDUCTOR. Homer D. Hagstrum (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 122: 83-113(Apr. 1, 1961).

The two-electron, Auger-type transitions which occur when an ion of sufficiently large ionization energy is neutralized at the atomically clean surface of a diamond-type semiconductor are discussed. Consideration of the basic elements of the problem leads to a computing program which enables one to calculate the total electron yield and kinetic energy distribution of ejected electrons in terms of a number of parameters. It is possible to account for the experimental results for singly-charged noble gas ions incident on the (111) faces of Si and Ge and the (100) face of Si. The fit of theory to experiment is unique in its principal features yielding numerical results concerning: (1) the state density function for the valence bands of Si and Ge, (2) the energy dependence of the matrix element as it is determined by symmetry of the valence band wave functions, (3) the effective ionization energy near the solid surface, (4) energy broadening, and (5) electron escape over the surface barrier. Over-all width of the valence band is found to be 14 to 16 ev for both Si and Ge. Width of the degenerate p bands is 5.1 ev in Si, 4.3 ev in Ge. The matrix element for p-type valence electrons is 0.3 times that for s-type valence electrons. Effective ionization energy is 2.2 ev less than the free-space value for 10-ev He^+ ions and decreases linearly with ion velocity. Energy broadening is small for 10-ev ions and increases approximately linearly with ion velocity. Probability of electron escape is several times that predicted for an isotropic distribution of excited electrons incident on a plane surface barrier. A general theory of Auger neutralization is given in which the conclusions of the fit to experiment are interpreted. Investigation of the matrix element as a Coulomb interaction integral involving wave functions whose general characteristics are known but which are not explicitly evaluated leads to an understanding of its principal dependencies on energy and angle. (auth)

16241 MICROWAVE ZEEMAN EFFECT OF FREE HYDROXYL RADICALS. H. E. Radford (National Bureau of Standards, Washington, D. C.). Phys. Rev., 122: 114-30 (Apr. 1, 1961).

Paramagnetic resonance absorption at 3-cm wavelength was observed in the products of an electric discharge in low-pressure H_2O and D_2O vapor. The spectra are of the electric dipole type, and arise from Λ-type doubling transitions in low-lying rotational levels of the free $O^{16}H$ and $O^{16}D$ radicals. The theory of the Zeeman effect in $^2\Pi$ levels of light diatomic radicals is extended to the general intermediate coupling case, and is used for a detailed analysis of the observed spectra. Numerical results of this analysis include molecular g factors precise to within 3 parts in 10^5, and magnitudes of the Λ-type doubling intervals in several low rotational levels. The measured g factors are compared with theory, including small corrections for molecular rotation, the anomalous spin magnetic moment of the electron, and estimated relativistic effects. This comparison yields the value 0.67 ± 0.01 for the molecular matrix element $(\Pi|L_y|\Sigma)$, and also brings to light serious discrepancies between the present experimental results and earlier measurements of the Λ-type doubling in OH and OD. The paramagnetic resonance spectra also exhibit hyperfine structure, from which are derived molecular constants that describe the distribution of unpaired electrons about the H or D nucleus. (auth)

16242 REFLECTION OF SLOW ELECTRONS FROM TUNGSTEN SINGLE CRYSTALS, CLEAN AND WITH ADSORBED MONOLAYERS. P. Kisliuk (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 122: 405-11 (Apr. 15, 1961).

The reflection of electrons with kinetic energy up to a few electron volts from tungsten single-crystal surfaces is measured both on the clean surface and with adsorbed monolayers of nitrogen and oxygen. For the clean surface, diffraction from the lattice is responsible for a considerable part of the reflection in the thermionic range of energy. The magnitude of the reflection is such as to have a barely measurable effect on experimental tests of the thermionic emission equations. This technique permits continuous recording of the change in work function as gas is adsorbed, yielding information about the kinetics of chemisorption and the surface dipoles due to the adsorbed gas atoms. (auth)

16243 STRUCTURE IN THE IONIZATION NEAR THRESHOLD OF RARE GASES BY ELECTRON IMPACT. S. N. Foner and B. H. Nall (Johns Hopkins Univ., Silver Spring, Md.). Phys. Rev., 122: 512-24(Apr. 15, 1961).

Ionization efficiency curves for xenon, krypton, and argon were studied with an electron energy analyzer. The electron energy distribution was measured and the absolute voltage scale determined in each experiment. The results of these studies (1) favor a linear threshold ionization law over a 1.127 power law, and (2) show that the data cannot be explained simply by ionization processes with onsets at the $^2P_{3/2}$ and $^2P_{1/2}$ ground states of the ion, but can be well fitted by a series of linear processes. The ionization potentials obtained by extrapolating according to a linear threshold law agree with spectroscopic values to within 0.02 ev. New onsets in argon were observed at about 0.64 v and 1.27 v above threshold. The observed structures in the rare gases are not readily explained by auto-ionization and no alternative explanation is offered. The structures observed in these experiments are compared with the results obtained by other "high-resolution" techniques. This comparison is complicated by the disparity in the published data on onset energies, and by the even greater disagreement on the relative probabilities for the various ionization processes. An independent check on consistency of data was made by comparison with "low-resolution" data obtained on a conventional mass spectrometer. The present data are in excellent agreement with the lower resolution data, while some of the other "high-resolution" data are not. (auth)

16244 SPECTRA INDUCED BY 200-Kev PROTON IMPACT ON HELIUM. R. H. Hughes, R. C. Waring, and C. Y. Fan (Univ. of Arkansas, Fayetteville). Phys. Rev., 122: 525-8(Apr. 15, 1961).

Spectra induced by 200-kev proton impact on helium was observed in the spectral region of λ3500 A to λ6000 A. ^1S states appear to be strongly excited. Absolute cross-sections for the direct excitation of the 4 ^1S and 5 ^1S states of neutral helium were determined as well as the simultaneous ionization and excitation cross-section for helium

into the n = 4 state of He^+. Of the more intense lines, only the $2\ ^1P-n\ ^1S$ lines and the He II λ4686 line behaved linearly with pressure within experimental error. Triplet spectra were observed in which the dominant feature was the $2\ ^3P-n\ ^3D$ lines. The populations of the $4\ ^3D$ and $4\ ^1D$ states, in particular, were analyzed as a function of a direct mechanism and collision of the second kind which seem to fit the data fairly well. A very weak Doppler-shifted H_β line was detected. If this is interpreted to be produced by charge exchange, then the cross section for electron capture into the n = 4 state of hydrogen is estimated to be of the order of 8×10^{-21} cm^2. (auth)

16245 ELECTRON CAPTURE FROM $He(1s^2)$ BY PROTONS. Robert A. Mapleton (Air Force Cambridge Research Center, Bedford, Mass.). Phys. Rev., 122: 528-33 (Apr. 15, 1961).

The two equivalent forms of Born's approximation, prior and post, are used to calculate the electron capture cross section for protons incident on $He(1s^2)$. These cross sections are calculated for capture into eleven different final states in the energy range 12.5 kev to 1 Mev. Although a rather crude wave function, $(Z^3/\pi a_0^3)\exp[-(Z/a_0)(r_1 + r_2)](Z = 1.6875)$, is used for He, the prior and post total capture cross sections do not differ by more than twenty percent over the energy range investigated. Estimates of the sum of the cross sections for capture into all s states of the hydrogen atom for the two residual ions, He^+ (1s) and He^+ (2s), are obtained from an adaption of the s-state sum rule as given in the paper of Jackson and Schiff. As in this work of Jackson and Schiff, it is found that the s states provide the major contribution to the total capture cross section. The calculated cross sections agree fairly well with the experimental values. The cross sections for capture into the state He^+ (1s) + H (1s), is roughly 2.5 times larger than the values obtained by Bransden, Dalgarno, and King. (auth)

16246 LARGE-SCALE ELECTRON BOMBARDMENT OF THE ATMOSPHERE AT THE SUDDEN COMMENCEMENT OF A GEOMAGNETIC STORM. R. R. Brown (Univ. of California, Berkeley), T. R. Hartz, B. Landmark, H. Leinbach, and J. Ortner. J. Geophys. Research, 66: 1035-41(Apr. 1961).

A burst of x rays was observed at balloon altitude over Alaska with the onset of a sudden commencement geomagnetic storm at 0146 UT on June 27, 1960. The electron bombardment of the upper atmosphere that gave rise to the x rays occurred on a large scale, ionospheric absorption coincident with the x-ray burst being observed by riometers in Alaska, Sweden, and Norway. (auth)

16247 RADIATION FROM A CURRENT FILAMENT ABOVE A HOMOGENEOUS EARTH, WITH APPLICATION TO MICROPULSATIONS. P. F. Law and B. M. Fannin (Univ. of Texas, Austin). J. Geophys. Research, 66: 1049-59(Apr. 1961).

If electromagnetic radiations from ionospheric current systems are considered sources of micropulsations, it becomes instructive to examine the following model problem: What are the electric and magnetic fields in the vicinity of a plane, homogeneous earth due to a line current source above this model earth? As the micropulsation frequencies are quite low (order of 1 cps), the near-field considerations become significant. The solution for this near field problem is presented, and the fields at the earth's surface are evaluated for a set of parameter values chosen to approximate an ionospheric source at a typical micropulsation frequency. (auth)

16248 IONOSPHERIC ELECTRON CONTENT AND ITS VARIATIONS DEDUCED FROM SATELLITE OBSERVATIONS. K. C. Yeh and G. W. Swenson, Jr. (Univ. of Illinois, Urbana). J. Geophys. Research, 66: 1061-7(Apr. 1961).

A procedure is given for correcting the effect of refraction and the high-frequency approximation when Faraday rotation measurement is available on two frequencies. This method is used to analyze the records obtained on the ground of radio transmissions from satellite 1958 δ_2 (Sputnik III). The result reveals strong diurnal as well as anomalous seasonal variations. The depression in electron content during magnetic storms is identified, and the preliminary observational result is not inconsistent with the drift theory. (auth)

16249 IONIZATION LOSS RATES BELOW 90 KM. Cullen M. Crain (RAND Corp., Santa Monica, Calif.). J. Geophys. Research, 66: 1117-26(Apr. 1961).

Quasi-equilibrium solutions for electron and ion density below 90 km are examined. Special attention is given to the present uncertainty in some of the rate coefficients and to the differences between daytime and nighttime results. (auth)

16250 SOLAR-STREAM DISTORTION OF THE GEOMAGNETIC FIELD AND POLAR ELECTROJETS. J. W. Kern (RAND Corp., Santa Monica, Calif.). J. Geophys. Research, 66: 1290-2(Apr. 1961).

It is shown that magnetic field gradients perpendicular to meridional planes may be introduced by solar-stream distortions of the geomagnetic field with the creation of polar electrojets. Longitudinal magnetic field gradients will lead to drift separation of geomagnetically trapped protons and electrons normal to field lines and in meridional planes, and thus to a suitable latitudinal charge separation in trapped radiation incident at auroral latitudes. (L.T.W.)

16251 THE INFLUENCE OF ^3He ON FILM FLOW. C. J. N. Van Den Meijdenberg, K. W. Taconis, and C. Le Pair (Kammerlingh Onnes Laboratorium, Leiden). Physics, 27: 117-43(Jan. 1961). (In English)

The isothermal flow of the film in equilibrium with liquid mixtures of He^3 and He^4 is investigated in the temperature range between 1.3°K and the λ-temperature. The flow rate is found to be dependent on the temperature, the concentration and the height of the film above the liquid level, but independent of the pressure head. The results can not be described with the simple formula $\sigma = A\ \rho s/\rho$, where A is a constant. The variation of the flow rate with the height of the film appears to depend on both temperature and concentration. Various flow measurements, including the present one, are considered in some detail in terms of the two fluid model. (auth)

16252 INTEGRAL RELATIONS FOR CALCULATING GAS FLOW WITH STRONG SHOCK WAVES. G. G. Chernyi. Priklad. Mat. i Mekhan., 25: 100-7(Jan.-Feb. 1961). (In Russian)

The propagation of plane, cylindrical, and spherical waves produced by a shock wave in a stationary gas was calculated using integral relations identical to those utilized in the theory of boundary layers in viscous liquids. (R.V.J.)

16253 DISSIPATION OF ARBITARY SHOCK IN MAGNETOHYDRODYNAMICS. V. V. Gogosov. Priklad. Mat. i Mekhan., 25: 108-24(Jan.-Feb. 1961). (In Russian)

A mathematical analysis is made of wave propagation in a medium with two-, three-, and four-wave combinations

llowing contact shock, rotational and contact shock, and patial shock in magnetohydrodynamics. (R.V.J.)

6254 THE STRUCTURE OF INCLINED MAGNETO-YDRODYNAMIC SHOCK WAVES. A. G. Kulikovskii and . A. Lyubimov. Priklad. Mat. i Mekhan., 25: 125-31 Jan.-Feb. 1961). (In Russian)

An analysis is made of the flow structure within a shock ave region in which energy dissipation results from mag-etic viscosity and secondary kinematic viscosity. (R.V.J.)

6255 MAGNETOHYDRODYNAMIC MIXED PROPAGA-TIONS. M. N. Kogan. Priklad. Mat. i Mekhan., 25: 132-7 Jan.-Feb. 1961). (In Russian)

Only one type of mixed propagation relating the transi-ion of elliptic pre-sonic flow to hyperbolic super-sonic low is known in hydrodynamics. It is shown that in mag-netohydrodynamics there are several types of mixed flows lescribed by the Trick equation $\varphi_{yy} - y\varphi_{xx} = 0$ and by a quite different equation $\varphi_{xx} - y\varphi_{yy} = 0$. The boundary prob-ems in these equations are formulated quite differently han those for Trick's equation for ordinary gas dynamics. Various types of mixed flow in ideal gases with infinite conductivity were analyzed, and equations and congruency laws are developed. (R.V.J.)

16256 IMPROVEMENTS IN THE LATTICE MODEL OF A LIQUID. H. N. V. Temperley (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London), 77: 630-42(Mar. 1, 1961).

A matrix approximation is introduced, with the objects of examining transitions of fluids of non-attracting rigid molecules, and of improving the lattice model of a liquid by reducing the ratio of mesh size to molecular volume. The approximation is first checked by applying it to some simple two-dimensional lattices, reproducing many known results and predicting some new ones. The probable qualitative behavior of the isotherm of a two-dimensional fluid of rigid non-attracting molecules is determined, available evidence suggesting the existence of a finite region in which the fluid phase is metastable. Some preliminary results on the effect of reducing the lattice mesh size suggest that simple lattice models of a liquid give physically sensible results in spite of their crudity. (auth)

16257 ON THE INVERSION TEMPERATURE FUNCTION OF THE FIRST ORDER (ONE PHONON) SCATTERING AND THE DETERMINATION OF DEBYE CHARACTERISTIC TEMPERATURES. M. L. Canut and J. L. Amorós (C.S.I.C., Madrid). Proc. Phys. Soc. (London), 77: 712-20 (Mar. 1, 1961).

Starting from Laval's expression for the first-order thermal diffuse scattering (TDS_1), an expression for the inversion temperature of TDS_1, $T_{max} = m\Theta_D^2 d_{hkl}^2 k/3h^2$, is obtained, valid for a crystal of any symmetry. T_{max} is attained when $\overline{(u^2)}^{1/2}/d_{hkl} = 16\%$. Every crystalline substance has a definite range where the above formula holds; the upper limit is T_{mp} and the lower limit is Θ_D. The melting temperature defines a d_{max} for which the inversion phenomenon can be observable. The inversion curves of TDS_1 are calculated for some metallic, ionic, and molecular crystals. It is shown that KCl, Pb, and Al are not special cases. In molecular crystals this effect is observable mainly at low temperatures. A method is given for determining a characteristic Θ_D for crystals of any symmetry. This method is tested using the experimental T_{max} for Pb. (auth)

16258 ON THE RECEPTION OF ELECTROMAGNETIC WAVES. H. Bondi (King's Coll., London). Proc. Roy. Soc. (London), A, 261: 1-9(Apr. 11, 1961).

The energy that can be obtained from an electromagnetic wave by a localized receiver is considered for the non-harmonic case. If the currents in the receiver are chosen so as to maximize the amount of energy obtained, with conditions implying that the receiver is quiescent outside a finite interval of reception, then there exists a well-defined maximum. For a limited interval of transmission, this maximum depends closely on the length of the interval of reception. If the restriction on the receiving current is relaxed, then there exist circumstances in which the wave theory considerations must be supplemented by allowing for induction effects. (auth)

16259 SELF-CONSISTENT PERTURBATION TREATMENT OF IMPURITIES AND IMPERFECTIONS IN METALS. N. H. March and A. M. Murray (Univ. of Sheffield, Eng.). Proc. Roy. Soc. (London), A, 261: 119-33(Apr. 11, 1961).

A full perturbation treatment of the Dirac density matrix is developed as a basis for self-consistent calculations in free-electron metals containing localized defects. The present perturbation series is shown to sum to the well-known result for the case of slowly varying potentials. To first order in perturbation theory, exact self-consistent results for the radial density of displaced charge and the Hartree potential in the presence of point singularities have been obtained over a density range sufficient to cover all metals under normal conditions. The basic limitations of Mott's first-order method, based on the assumption of slowly varying potentials, are shown to be completely removed and the self-consistent density and potential display long-range oscillations. Finally, the application of the present approach to Bloch wave functions rather than plane waves is briefly considered. Friedel's generalized first-order method, applicable to a band structure, may be obtained from the present theory for sufficiently slowly varying potentials. Unfortunately, such an assumption is seen by comparison with the free-electron findings to lead to serious errors. (auth)

16260 ON SOME PECULIAR ROLE OF THE COSMOLOGICAL CONSTANT IN THE GENERAL THEORY OF RELATIVITY AND IN THE SCHRÖDINGER THEORY OF NON-SYMMETRIC FIELD. Hidekazu Nariai and Yoshio Ueno (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 24: 1149-65(Dec. 1960). (In English)

The peculiar role of the so-called cosmological constant Λ is investigated from two alternative standpoints of the general theory of relativity and the Schrödinger theory of nonsymmetric fields. It is shown that, in spite of a rather drastically different character of the latter theory from the former, there exists a peculiar solution whose existence is assured by the role of Λ and whose physical meaning is equivalent to that of Bertotti's solution in general relativity. (auth)

16261 LATTICE VIBRATION AND RANDOM WALK PROBLEMS. Ei Teramoto (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 24: 1296-1306(Dec. 1960). (In English)

Mathematical relations between the lattice vibration and the random walk problems are presented for the case of a system of one-dimensional harmonically coupled oscillators. Namely it is shown that the Laplace and Mellin transforms of the frequency spectrum of the lattice vibration can be expressed in terms of the transition probabilities of the random walk problems with the continuous and discrete time parameters, respectively. (auth)

16262 TIME DEPENDENT PROBLEMS OF THE LOCALIZED LATTICE VIBRATION. Ei Teramoto (Kyoto Univ.) and Shozo Takeno. Progr. Theoret. Phys. (Kyoto), 24: 1349-68(Dec. 1960). (In English)

The time dependent problems of vibrational motion are investigated for the cases of an infinitely extended one-dimensional lattice which contains one or two impurity atoms (isotopes). Starting from the equations of motion of these systems, integral equations are derived which show various time dependent properties of the lattice vibration of these perturbed one-dimensional lattices. Namely, the asymptotic solutions of these integral equations represent the localized vibration which is preserved by the impurity atom when its mass is smaller than that of base atoms. The integral equations are actually solved by means of the perturbation calculation and also by the use of Laplace transforms, and the behaviors of the lattice vibration, especially the capture of the vibrational energy by the impurity atoms, are examined. (auth)

16263 VICTAWET AND SODIUM METAPHOSPHATE AS PARTING AGENTS FOR ELECTRON MICROSCOPE REPLICAS. J. O. Stiegler and T. S. Noggle (Oak Ridge National Lab., Tenn.). Rev. Sci. Instr., 32: 406-8(Apr. 1961).

It is shown that the active material obtained in the use of Victawet as a parting layer for electron microscope replicas is the inorganic decomposition product sodium metaphosphate (S.M.P.). The results of an investigation of the parting layer characteristics of S.M.P. suggest its use in applications which have previously employed Victawet. Measurements with radioactive tracers indicate that on smooth surfaces reproducible stripping can be realized with parting layers of S.M.P. a few molecular dimensions in thickness. The use of a ribbon filament source with this material is recommended to minimize shadowing effects and thus reduce the thickness of S.M.P. required for successful stripping. (auth)

16264 CRYSTAL "DOPING" BY ION BOMBARDMENT. F. M. Rourke, J. C. Sheffield, and F. A. White (Knolls Atomic Power Lab., Schenectady, N. Y.). Rev. Sci. Instr., 32: 455-6(Apr. 1961).

The doping of metals and semiconductors with highly resolved ion beams eliminates reagent impurity contamination, provides high isotopic enrichment, and allows cross section determinations with 10^{-8} to 10^{-11} g of material thus eliminating self-shielding. To control the penetration depth of the bombarding ions in a magnetic analyzer, a variable high-voltage bias is used. In semiconductor research ionic doping is utilized to make shallow p-n or n-p junctions by impregnating a crystal of silicon with group III or V elements. An ion bombardment technique is also being employed to determine if diffusion coefficients can be obtained by impregnating metallic filaments with a multiplicity of elements and isotopes. These lattice diffusion studies are an attempt to investigate whether the usual temperature dependence $D = D_0 \exp(-\epsilon/kT)$ has experimental validity on a microscopic scale. (N.W.R.)

16265 APPLICATION OF QUANTUM FIELD THEORY IN STATISTICAL PHYSICS. A. I. Alekseev. Uspekhi Fiz. Nauk, 73: 41-88(Jan. 1961). (In Russian)

Thermodynamic perturbation theory is analyzed on the basis of quantum field theory, and the applications of the mathematical apparatus in statistical physics are reviewed. Green's thermodynamic functions, Green's time dependent functions, and certain examples of their applications are discussed. 63 references. (R.V.J.)

16266 FUNDAMENTALS OF MODERN PHYSICS. Robert Martin Eisberg. New York, John Wiley & Sons, Inc., 1961. 739p.

An integrated presentation is given to relativity theory, the old quantum theory, and quantum mechanics. These theories are then used in a discussion of atoms and nuclei. A rapid but thorough treatment of the important developments leading up to Schroedinger quantum mechanics is presented in a careful introduction to the basic theory, using an inductive rather than a postulatory approach and illustrating the theory through a complete discussion of a large number of typical calculations. Then the theory is used to give a detailed explanation of the properties of atoms and nuclei. Various interactions present in multi-electron atoms are also treated. The discussion of nuclei is based upon a treatment of each of the important nuclear models, and the entire subject of nuclear forces is thoroughly reviewed. (N.W.R.)

16267 PROCEEDINGS, THERMOELECTRIC SYMPOSIUM, WHIRLPOOL CORPORATION, WASHINGTON, D. C., OCTOBER 21, 1959. St. Joseph, Mich., Whirlpool Corporation, 1959. 199p.

A symposium on developments in thermoelectricity was held in Washington, D. C., October 21, 1959. Topics discussed include a review of developments in thermoelectric cooling, the design of controlled temperature chambers heated and cooled by thermoelectricity, applications of thermoelectricity to refrigerated spaces aboard submarines, design and applications of thermoelectric distillation apparatus, applications of thermoelectricity to equipment for food handling, the development of thermoelectric materials, the design of a thermoelectric generator element, and the development of thermoelectric valves and pumps. The theoretical basis for the Peltier effect and the Seebeck effect for direct conversion of heat to electric power were discussed. Semiconductor materials discussed at length include Bi_2Te_3 systems, PbTe alloys, Ge, and Ag_2Se alloys. Practical applications of thermoelectric systems include the design of heating and cooling equipment for a variety of research and future commercial applications. These include a refrigeration system for submarines, a thermoelectric still, a thermoelectric freezer-oven for the frozen storage and heating of prepared meals during flight; a thermoelectric refrigerator which eliminates all moving parts by directly converting electricity to cold, structural panels which both heat and cool a room thermoelectrically, and thermoelectric valves and pumps for vacuum or liquids. Developments in thermonuclear research in Russia are also reviewed. Among the unique developments are thermoelectrically-cooled plates for a microtome to aid the pathologist in making very thin frozen sections of tissues for examination during an operation, and a thermoelectrically cooled stage for a microscope. (C.H.)

Astrophysics and Cosmology

16268 (AFSWC-TR-60-57) PHYSICS OF THE VAN ALLEN RADIATION BELTS. Donald C. Hock (Radiation, Inc., [Melbourne, Fla.]). Dec. 1960. Contract AF29(601)-2348. 116p.

A study was made of the physical aspects of the Radiation Belts, which deals with geomagnetically trapped electrons from neutron albedo decay. The analysis assumes a decay density function which fits the results of Hess' calculations and computes the angular distribution and intensity of the source and the energy spectrum of the injected electrons. The life expectancy of the electrons is discussed relative to the manner in which the electrons lose energy: by pure energy loss, scattering without energy loss, or by scattering and energy loss. The degeneracies in the radiation belts are reviewed. A discussion is given of the energy

s of protons caused by scattering from atmospheric nstituents. Considerations for long and short range coulb collisions are given. Approximate energy losses om coulomb collisions in ionized and neutral hydrogen, nized oxygen, and air are presented. The breakdown of e adiabatic invariants is discussed. A curve is prented showing the maximum allowed proton energy trapble as a function of distance from the center of the earth cause of the change in the magnetic moment of the pron. A study was made of the variations and fluctuations in e belt with respect to time and space. The azimuthal drift trapped particles and radial motion of trapped particles discussed. A consideration of how far north trapping is fective is given. The design of an experiment to perform easurements on Van Allen radiation of value to the Argus fect is undertaken. An experiment is suggested which uld show the existence of Alfven waves. In another exeriment, ways to measure the source of electrons found in e inner radiation belt, which are not accounted for by theral neutron decay theory, are discussed. A third suggested xperiment would determine possible electron loss mehanics. (auth)

16269 (SCR-252) SOLID INTERPLANETARY MATTER. David Beard (California. Univ., Davis). Jan. 1961. 12p.

Sandia Corporation Research Colloquium.

Discussions are given of the occurrence and size of omets and meteors, observations of the zodiacal light, nd interplanetary dust and its effects on space vehicles. 3 references. (B.O.G.)

16270 (NP-tr-575) BETA-PROCESSES AND ASTROPHYSICS. D. A. Frank-Kamenetskii (Frank-Kamenetskiy). Translated from Uspekhi Fiz. Nauk, 58: 415-32(1956). 32p.

A discussion is given of β-processes in connection with energy generation in stars. The rate of energy generation rom proton-proton reactions: $p + p \rightarrow d + \beta^+ + \nu$, is described. Considerations are given for a model to determine whether the hydrogen cycle is a sufficient explanation of energy generation in stars. The results of the solution are shown graphically. The determination of the constant of the β-process from the properties of the sun is discussed. An appraisal is given of the astrophysical and the terrestrial values of the constant of triplet β-interaction. A discussion is given of the structure and interior density of stars to explain the discrepancy in the astrophysical and terrestrial values of the β-process constants as determined from the hydrogen-helium model. (B.O.G.)

16271 THE ABUNDANCE OF BERYLLIUM IN FOUR STARS OF TYPE A. Walter K. Bonsack (Carnegie Institution of Washington, D. C. and California Inst. of Tech., Pasadena). Astrophys. J., 133: 551-61(Mar. 1961).

By means of a curve-of-growth analysis of high-dispersion spectrograms, the ratio of the abundance of Be to that of Fe was determined for α^2 CVn (A0p) and α CMa (A1 V) relative to the ratio in α Lyr (A0 V). In addition, the position of α Gem A (A1 V) on the abundance scale so defined was estimated. The absolute ratio of Be to H was obtained for α Lyr with the aid of a published model atmosphere. The results show that the abundance of Be in α Lyr is approximately one-fourth of the solar abundance ($Be/H = 10^{-10}$); the Be-to-Fe ratio in α CMa is at least 40 times less than in α Lyr, and in α^2 CVn it is 25 times more. The abundance ratio in α Gem A appears to be similar to that in α Lyr. The absence of Be in α CMa is interpreted as a possible consequence of the transfer of matter from its white dwarf companion when the latter was an M supergiant. The Be abundance difference between α^2 CVn and α Lyr, together with the apparent absence of mechanisms to reduce the initial surface abundance in α Lyr more than in α^2 CVn, suggest the active production of Be on the surface of α^2 CVn, probably in the early phases of its evolution. This suggestion, taken together with the evidence available on the abundance of lithium, indicates that the origin of Li, Be, and B is probably in nuclear processes at the surfaces of newly formed stars. (auth)

16272 OSCILLATOR STRENGTHS OF LEAD AND THE LEAD ABUNDANCE IN THE SUN. T. M. Helliwell (California Inst. of Tech., Pasadena). Astrophys. J., 133: 566-71(Mar. 1961).

The oscillator strengths of four transitions in neutral lead were calculated and compared with recent experimental results. The method of calculation is described. These values are used to investigate the problem of lead abundance in the sun, which is compared with the abundance predicted by the theory of stellar nucleosynthesis. (auth)

16273 DEPARTURES FROM THE SAHA EQUATION FOR IONIZED HELIUM. I. CONDITION OF DETAILED BALANCE IN THE RESONANCE LINES. Richard N. Thomas and J. B. Zirker (National Bureau of Standards, Boulder, Colo. and Sacramento Peak Observatory). Astrophys. J., 133: 588-95(Mar. 1961).

Conditions for the validity of the assumption of detailed balance in the Lyman lines of He_{II} are investigated. An opacity of 10^6 in Lyman-α is required, which implies high opacity in the subordinate lines and resonance continuum. The b_n-factors are computed, including the transfer problem in the subordinate lines and resonance continuum. (auth)

16274 THE SOLAR LYMAN-ALPHA EMISSION LINE. Donald C. Morton and Kenneth G. Widing (U. S. Naval Research Lab., Washington, D. C.). Astrophys. J., 133: 596-605(Mar. 1961).

The Jefferies and Thomas theory of line formation by non-coherent scattering in a non-equilibrium chromosphere is applied to the solar Lyman-α profiles recently photographed by a rocket spectrograph. A Planck function decreasing exponentially with increasing optical depth is assumed for the electron-temperature distribution. The theory successfully accounts for the cores of the observed profiles with their two peaks separated by shallow reversals, but the predicted wings always fall off too sharply. The depths of the reversals show that the line originates in the regions of steepest temperature gradient. The separations of the peaks suggest electron temperatures of 70,000°K for the plages and 90,000°K for the surrounding darker areas. The absolute intensities require electron densities ranging from 3×10^{10} to 2×10^9 cm^{-3} for these respective regions. (auth)

16275 A COMMENT ON THE NRL SOLAR LYMAN-ALPHA RESULTS. J. T. Jefferies and R. N. Thomas (National Bureau of Standards, Boulder, Colo.). Astrophys. J., 133: 606-7(Mar. 1961).

Supplementary comments are made on the Morton-Widing analysis of the NRL Ly-α observations; they serve to bring into sharper focus its relation to current attempts at analysis of self-reversed emission cores of collision-dominated lines for gradients of T_e, for chromospheric structure, and for differential structure between quiet sun and plage, sunspot and flare regions. (auth)

16276 INTERPLANETARY GAS. III. A HYDRODYNAMIC MODEL OF THE CORONA. Joseph W. Chamberlain (Yerkes Observatory, Williams Bay, Wis.). Astrophys. J., 133: 675-87(Mar. 1961).

The ionized interplanetary gas is viewed as an outer ex-

tension of the solar corona and is discussed with the scalar equations of hydrodynamic motion, continuity, and the first law of thermodynamics with heat conduction. This approach is contrasted with the evaporative theory of Paper II. Although there are differences in the results of the two theories arising from the different assumptions inherent in their formulations, similar solutions appear in the two cases. Specifically, the hydrodynamic treatment allows a solution in which both the expansion velocity and the density vanish at infinite distance. Indeed, it is argued that the high expansion velocities necessary for a steady "solar wind" require the basic assumption of an accelerating mechanism in the corona and that a solar wind is not an inevitable phenomenon. Further, coronal observations offer no basis for suspecting an outward expansion of the interplanetary gas faster than several kilometers per second at the earth's orbit—corresponding to a gentle "solar breeze." At the earth's orbit the temperature is governed by adiabatic equilibrium and is predicted to be in the neighborhood of 15,000 to 20,000°K. Closer to the sun, conduction appears to become important, as advocated by Chapman, giving a much smaller temperature gradient. The density at the earth is computed to be around 30 electrons/cm^3. (auth)

16277 INTERPLANETARY GAS. IV. NEUTRAL HYDROGEN IN A MODEL SOLAR CORONA. John C. Brandt (Yerkes Observatory, Williams Bay, Wis.). Astrophys. J., 133: 688-700(Mar. 1961).

The problem of the distribution of neutral hydrogen in a model solar corona is investigated. Hydrogen is considered as created by recombinations, destroyed by collisions and photoionization, and transported by diffusion. The diffusion cross section is taken as that for charge exchange, and the effects of radiation pressure from solar Lyman-α are included. A model with an electron density near the orbit of earth of the order of $10^2/cm^3$ yields sufficient hydrogen beyond the earth to back-scatter solar Lyman-α and produce the observed night-sky radiation. (auth)

16278 THE DISTRIBUTION OF HYDROGEN IN THE TELLURIC HYDROGEN CORONA. Francis S. Johnson (Lockheed Missiles and Space Div., Palo Alto, Calif.). Astrophys. J., 133: 701-5(Mar. 1961).

The distribution of hydrogen in the telluric hydrogen corona is calculated by identifying the components of a fictitious hydrostatic distribution which are actually present in the real atmospheric distribution. The components which are clearly present are the captive ballistic orbits and the escaping ballistic orbits which originate near the base of the exosphere. The components which are clearly absent are the hyperbolic orbits which originate in space; these consist of two groups, those which do not intersect the base of the exosphere and which return to space and those which intersect the base of the exosphere and which are capture orbits. Trapped elliptic orbits, or satellite orbits, may or may not be present, but near the earth they are probably occupied. Each of these components can be evaluated as an explicit portion of a hydrostatic distribution, and the distribution calculated from the hydrostatic distribution in a straightforward manner. Calculations are presented for temperatures of 1000° and 1500°K. (auth)

16279 THE USE OF HIGH-SPEED COMPUTERS FOR THE SOLUTION OF THE RESTRICTED THREE-BODY PROBLEM BY THE HILL-BROWN METHOD. PART I. CALCULATION OF THE RIGHT-HAND MEMBERS OF NON-HOMOGENEOUS EQUATIONS. V. A. Shor. Byull. Inst. Teoret. Astron., 7: 639-75(1960).

The development of the Hill-Brown method for the theory of motion of irregular Jovian satellites with the use of high-speed computers is described. As a first attempt, equations in non-homogeneous form were used, although they are not so accurate as homogeneous equations, because of the lesser labor consumption. The sequence of calculations was chosen so that it should best be fitted to the operation of a "Strela" computer which has 2,047 cells in the operational memory plus a magnetic tape storage and whose calculation speed amounts to 2000 operations per second. In the expansions of perturbation function derivatives, the terms were retained which are not higher than α^2e', $\alpha e'^2$, e'^3, α^2z^2, since this procedure is sufficient to ensure the accuracy of 0.1" in geocentric longitude as was estimated by Tokmalayeva in 1956. (auth)

16280 ON THE RELATIVISTIC ELECTRONS IN THE SOLAR ATMOSPHERE. Kunitomo Sakurai (Kyoto Univ.). J. Geomagnet. Geoelec., 12: 70-6(1961). (In English)

The various processes of the relativistic electrons ejected in association with flares are considered and these electrons are examined for their loss of energy. These electrons are trapped in the sunspot magnetic fields (~100 gauss) and then lose the majority of their energies through the synchrotron radiation. The radio waves emitted by these synchrotron radiation processes are observed as the type IV outbursts. (auth)

Cosmic Radiation

16281 (JPLAI-LS-230) COSMIC RAY MEASUREMENTS AND MEASURING DEVICES. ASTRONAUTICS INFORMATION Literature Search No. 230. Esther Pereira (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Jan. 1960. Contract NASw-6. 83p. (AD-245545)

A survey was made of the periodical and report literature published from 1958 through 1960 on cosmic rays with emphasis on Cherenkov radiation. The material is divided into 2 main categories: general information and Cherenkov radiation, with subheadings of theory, instrumentation, and measurements. Under each subject heading reports were arranged in alphabetical order by source, books by author, and periodicals by journal name. (auth)

16282 (P-1891(RAND)) POWERPLANTS FOR ATMOSPHERIC AND SURFACE VEHICLES ON MARS. W. H. Krase (RAND Corp., Santa Monica, Calif.). Jan. 25, 1960. 22p.

An investigation was made of powerplants for use on Mars (as distinct from those used in getting to Mars), to supply powerplant data for a companion study of surface and atmospheric vehicles. The powerplants include atmosphere-breathing systems using nuclear and chemical heat sources, chemical rockets, and a rocket-turbine in which rocket chamber exhaust feeds a turbine to produce shaft power. Chemical energy sources include mono- and bi-propellants, reactions with the atmosphere, and propellants which can be made from native atmospheric materials. An estimate of the mass of a nuclear plant for this purpose is included. Rocket-turbine powerplants using high energy cryogenic materials are capable of very low specific mass (~.15 lb/hp) and propellant consumption (~1.3 lb/hp-hr). Nuclear-powered, manned vehicles on Mars would be unreasonably large because of the mass of the biological shield. For long-term stationary applications a nuclear powerplant is required, and can be used to make propellants from native water vapor or carbon dioxide, once the atmospheric properties are known. Although some materials, notably boron and beryllium, are known to react exothermically with nitrogen, thought to be the major atmospheric constituent of Mars, the scanty thermo-chemical data now available sug-

t that the propellant consumption and weight of atmos-re-breathing engines would be several times the values ievable with rocket-turbine engines, even presuming the midable combustion problems can be solved. The re-ed technology for Mars powerplants is available or be- developed. The rocket-turbine will be based on existing ket and accessory turbine experience. For later, more bitious requirements, self-contained nuclear power-nts may be developed based on electrical space pro-sion systems. (auth)

283 GEOGRAPHICAL ASPECTS OF COSMIC-RAY UDIES. Serge A. Korff (New York Univ., New York). ograph. Rev., 50: 504-22(Oct. 1960).

The advantages of high-mountain stations for cosmic-ray dies are discussed. It is pointed out that such stations ovide a place to which heavy equipment can be carried d at which observations can be made as long as required. ile airplanes can fly to higher elevations they cannot rry such heavy equipment or remain as long; balloons n go higher than airplanes, but are still more limited in e weight they can support; rockets and satellites can go ch higher than balloons, but both are limited in the ight they can support, and rockets stay at high elevations r only very short times. In 1960 there were about 60 or cosmic ray observing stations located above 10,000 ft. actors influencing the location of these stations are dis-ssed. Current trends in cosmic ray research are re-ewed. Applications of C^{14}, tritium, helium, and Be^{10} in udies on the composition and history of the earth, applica-ons of cosmic ray studies in the field of solar-terrestrial elationships, applications in determining the interrelation-ips between the branches of geophysics, and applications studies on the environment of the earth are discussed riefly. Data on the relative values of cosmic ray intensity t sea level are presented for various longitudes. (C.H.)

6284 THE SPECTRUM OF COSMIC RAYS AND THEIR OLE IN COSMIC GAS DYNAMICS. S. I. Syrovatskii. oprosy Magnit. Gidrodinamiki i Dinamiki Plazmy, Trudy onf. Akad. Nauk Latv. S.S.R., Inst. Fiz., 45-8(1959).

The present hypotheses of cosmic ray origin make it ossible to explain the observed differential energy spec-rum $N(\epsilon)\, d\epsilon = k\epsilon^{-\gamma} d\epsilon$, where $\gamma = 1 + 1/\alpha T$, with $2 < \gamma < 3$. ere α is a certain coefficient, and T is the average article-acceleration time. However, in consequence f the strong dependence of γ on α and T and the possible ariations of α and T in wide limits for the various cosmic bjects, the value $\gamma \approx 3$ appears as random. It seems to be more probable that the energy spectrum of the cosmic rays epresents the consequence of the general properties of lynamics of gaseous objects. It is assumed that the system embracing the turbulent ionized medium and relativistic articles, tends to the dynamic equilibrium state, for which the energy of the relativistic particles and the turbulence energy are connected by the correlation $E_{rel} = \delta E_{turb}$, where $\delta \approx 1$. If an intense turbulent motion arises within an arbitrary limited volume (as an example, the flash of a Supernova) and acceleration of the particles up to relativ-istic energies begins, the total energy of the system dimin-ishes in consequence of the leakage of the relativistic parti-cles into the surrounding space. It is shown that the energy spectrum of these particles has the form $N(\epsilon)\, d\epsilon = K\epsilon^{-(2+\delta)} d\epsilon$, where the exponent is $\gamma = 2 + \delta \approx 3$, ($\delta \approx 1$). Because the obtained form of the spectrum does not depend on the specific properties of the source, the sum spectrum of the cosmic rays is the same for the existence of a great quan-tity of sources. (auth)

16285 SATELLITE-BORNE INSTRUMENTATION FOR OBSERVING FLUX OF HEAVY PRIMARY COSMIC RADIATION. P. Schwed, M. A. Pomerantz, H. Hanson, and H. Benjamin. J. Franklin Inst., 271: 275-91(Apr. 1961).

A lightweight (1150-gram) instrument for measuring the flux of relativistic heavy primary cosmic ray nuclei of $Z \geq 6$ and separating these into three categories according to charge is described. The detector is an ionization chamber 11 cm in diameter and 11 cm long filled with 9 atmospheres of argon. The associated electronics which consists of a 400-volt supply for the ionization chamber, a high input impedance amplifier, and a three-channel pulse-height analyzer is completely transistorized and consumes 54 mw. (auth)

16286 OBSERVATIONS NEAR THE NORTH AND SOUTH POLES OF BURSTS OF COSMIC RAYS FROM THE SUN. M. A. Pomerantz, S. P. Duggal, and K. Nagashima. J. Franklin Inst., 271: 317-26(Apr. 1961).

The first simultaneous observation at Thule, Greenland, and McMurdo Sound, Antarctica, of the sudden arrival of solar-produced cosmic radiation of sufficient energy to be detectable at ground stations is reported. Two distinct events occurred on November 12 and November 15, 1960, and they are presented in tabular and graphical representations. (N.W.R.)

16287 UNUSUAL INCREASE IN THE COSMIC RAY INTENSITY ON NOVEMBER 20, 1960. M. A. Pomerantz and S. P. Duggal. J. Franklin Inst., 271: 327-335(Apr. 1961).

An unusual increase in the cosmic-ray intensity occurred at about 2100 U.T. on November 20, 1960, and the relevant data are presented from the McMurdo and Thule stations. (N.W.R.)

16288 MOTION OF LOW-ENERGY SOLAR COSMIC RAY PARTICLES IN THE EARTH'S MAGNETIC FIELD. Kunitomo Sakurai (Kyoto Univ.). J. Geomagnet. Geoelec., 12: 59-69(1961). (In English)

The orbits of the low-energy solar cosmic-ray particles in the earth's dipole magnetic field are calculated and are used to estimate the asymptotic velocity vectors entering magnetic field. Although the incident region of these particles is restricted in the area of higher geomagnetic latitudes than 60°, it is clear that there are anisotropic effects, i.e., impact zone effects for the incidence of these particles. Furthermore, the precipitation lines of the incidence are shown to be circular around the geomagnetic north pole. The comparison of the calculated results with the observed data shows that these low-energy cosmic-ray particles tend to impinge upon the earth anisotropically, and that, slightly before the onset of geomagnetic Sc storms, their anisotropic incidence changes into isotropic one, although there are some exceptional cases. Finally, criticisms and a possible explanation on the features of their incidence after the onset of geomagnetic Sc storms are proposed. (auth)

16289 THE TIME VARIATIONS OF SOLAR COSMIC RAYS DURING JULY 1959 AT MINNEAPOLIS. J. R. Winckler, P. D. Bhavsar, and L. Peterson (Univ. of Minnesota, Minneapolis). J. Geophys. Research, 66: 995-1022(Apr. 1961).

Thirteen high-altitude balloon flights were made at Minneapolis, Minnesota, during the period July 10—18, 1959. Measurements with ion chambers, Geiger counters, and scintillation counters of the solar cosmic rays accompanying three large flares during that period are summarized. Very large fluxes were observed beginning with the main phase of each of the three geomagnetic storms following the flares. During this main phase period, the instrumental results are consistent with protons having a steep energy spectrum and a lower limit at the air cut-off. For example, at 1046 UT on July 15 the integral energy

spectrum for protons valid between 88 and 300 Mev was found to be $N(>E) = 1.05 \times 10^8 E^{-2.9}/cm^2 \cdot sec \cdot ster$. The large increase observed in each storm can be interpreted as a rapid decrease in the cosmic-ray geomagnetic cut-off coincident with the start of the main phase of the storm. The flux returned to normal much sooner than the recovery of the main field of the earth. At the time of the sudden commencement of the geomagnetic storm, a rapid and appreciable decrease of residual low-intensity solar cosmic rays was observed in two cases. It is suggested that these effects may be produced by ring current systems in the outer field of the earth associated with the geomagnetic storm. Following the July 15 increase, intensity oscillations in the solar proton stream with a period of ½ hour were observed. These oscillations are of unknown origin. (auth)

16290 THE HIGH-ENERGY COSMIC-RAY FLARE OF MAY 4, 1960. PART I. HIGH-ALTITUDE IONIZATION AND COUNTER MEASUREMENTS. J. R. Winckler, A. J. Masley, and T. C. May (Univ. of Minnesota, Minneapolis). J. Geophys. Research, 66: 1023-7(Apr. 1961).

Total ionization and counting rate measurements were made at 6 g/cm^2 depth at Minneapolis in the period from 7 to 16 hours following the cosmic-ray flare of May 4, 1960. The excess energy influx 7 hours after the flare was 340 $Mev/cm^2 \cdot sec$ in an atmospheric column. The omnidirectional ionization and counting rates were about 25% above normal and the ionization ratio per particle was 1.2 times normal galactic cosmic rays at the same altitude. This is consistent with the high-energy nature of the event and contrasts greatly with the steep low-energy spectrum frequently observed during geomagnetic disturbances at Minneapolis. There is evidence for a displaced impact zone effect in the period 7 to 15 hours after the flare. (auth)

16291 THE HIGH-ENERGY COSMIC-RAY FLARE OF MAY 4, 1960. [PART] 2. EMULSION MEASUREMENTS. S. Biswas and P. S. Freier (Univ. of Minnesota, Minneapolis). J. Geophys. Research, 66: 1029-33(Apr. 1961).

The differential energy spectrum of solar protons from the flare of May 4, 1960, was measured in emulsions during a balloon flight from 1700 UT on May 4 to 0200 UT on May 5. An increased flux of protons of rigidity 0.7 to 1.6 bv of 600 ± 150 $particles/cm^2 \cdot sec \cdot ster$ was measured. The differential rigidity spectrum in this interval can be expressed as $(dN/dR) = [(0.65 \pm 0.15) \times 10^{-3}/R^{1.1 \pm 0.5}]$ $protons/m^2 \cdot sec \cdot ster \cdot bv$. There were no solar α particles present during this time. The flux of $Z \geq 3$ nuclei was normal. (auth)

16292 SHORT-TERM VARIATIONS IN MESON AND NUCLEON COMPONENT OF COSMIC RAYS. V. L. Patel and K. Maeda (Univ. of Maryland, College Park). J. Geophys. Research, 66: 1286-7(Apr. 1961).

A fairly constant ratio for decreases in nucleon and meson components of cosmic radiation can be calculated if the meson data are corrected by using radiosonde data. Data are compared from a meson telescope and from a neutron monitor located at Thule ($\lambda = 89°N$). The ratios vary considerably from event to event. The average value is 1.32. The dispersion is so high that the lowest value differs 28% and the highest value differs 23% from the average. Then the meson intensity was corrected for 300-mb height level using radiosonde data. The average value is $\alpha = 1.22$. The error in daily mean of meson intensity is 0.09% and in nucleon intensity, 0.14%; 0.1% is added to both to account for inaccuracy in atmospheric correction and random error. A simple calculation gives an error in each ratio of ±0.31; hence an error of ±0.13 in the average α. (L.T.W.)

16293 A NOTE ON SOLAR FLARE COSMIC RAYS. K. Maeda and V. L. Patel (Univ. of Maryland, College Park). J. Geophys. Research, 66: 1288-9(Apr. 1961).

Recently, contradictions have arisen among the results of investigations on the effects of solar flares upon the cosmic-ray intensity, using Chree's analysis or the method of superposition. It is pointed out that these discrepancies can be interpreted in terms of the selection of data used in the analyses. (L.T.W.)

16294 VARIATION IN PRIMARY α-PARTICLE INTENSITY AND COSMIC RADIATION. E. Waibel (Max-Planck-Institut für Aeronomie, Lindau/Harz, Ger.). Nuovo cimento (10), 19: 482-96(Feb. 1, 1961). (In Germa

The primary α-particle intensity and the total cosmic radiation were measured over Northern Germany (cut-off for protons 1.46 Bev, eccentric dipole) with a balloon sond during a strong Forbush effect on July 16, 1959. The vertical α-particle flux extrapolated to 0 g/cm^2 was found to b (0.0105 ± 0.0007) $(cm^2 s\ sr)^{-1}$, allowing for the fragmentati of heavier nuclei. The extrapolated value of the total radia tion amounted to (0.0891 ± 0.0015) $(cm^2 s\ sr)^{-1}$. On November 3, 1959, the measurement of the α-particles showed a extrapolated vertical flux of (0.0124 ± 0.0025) particles/$(cm^2 s\ sr)$ and the total radiation amounted to (0.1043 ± 0.0042) particles/$(cm^2 s\ sr)$ (cut-off for protons 1.72 Bev). A comparison of the radiation values from July 16, 1959, Nov. 3, 1959, and Apr. 4, 1957 proved a variation of the hard component at high altitudes which was larger by the factor 1.9 ± 0.3 than that of neutrons on ground level at Lindau. For the α-particles this variation factor was 1.5 ± 0.5. (auth)

16295 NUCLEAR INTERACTIONS OF PROTONS, NEUTRONS, AND SHOWER PARTICLES OF VERY HIGH ENERGY IN NUCLEAR EMULSION. A. G. Barkow, B. Chamany, D. M. Haskin, P. L. Jain, E. Lohrmann, M. W. Teucher, and Marcel Schein (Univ. of Chicago). Phys. Rev., 122: 617-25(Apr. 15, 1961).

Eighty-four interactions of protons and neutrons were located in a 22 liter stack of nuclear emulsion by tracing back showers of minimum-ionizing particles to their origins. The distribution of the number of shower particles, and the number of heavily ionizing prongs are presented for 57 events with dip angles <17°. The average energy of these events is 3.5×10^{12} ev. The average number of shower particles emitted in nucleon-nucleon collisions at this energy is 15 ± 5, as estimated from 8 interactions without heavy prongs. The angular distributions of the shower particles are presented for the 57 events. They can be transformed into a system in which the angular distribution is roughly symmetric. This is true even for the collisions with heavy target nuclei ($N_h > 5$). The degree of anisotropy of the angular distributions is in disagreement with a hydrodynamical model of nucleon-nucleus collisions. A lower limit for the collision mean free path of the primary particles of 20 cm in emulsion was obtained. By scanning the forward cone of the primary interactions, 76 secondary interactions of charged and neutral shower particles were found. The distribution of the prong numbers, of the energy, and the characteristics of their angular distribution are presented. The best estimate of the ratio of secondary collisions produced by neutral particles, and the number produced by charged particles is: $N_h/N_{ch} = 0.40 \pm 0.11$. Adding this result to other published data, it is concluded that 30 ± 6% of the particles produced in collisions having a primary energy of several Tev are not π

sons. A collision mean free path of 41 ± 8 cm was found the forward-cone shower particles. (auth)

296 ANGULAR DISTRIBUTIONS OF SECONDARY RTICLES PRODUCED IN HIGH-ENERGY NUCLEAR LLISIONS AND THE TWO-CENTER MODEL OF MUL-PLE MESON PRODUCTION. J. Gierula, D. M. Haskin, E. Lohrmann (Univ. of Chicago). Phys. Rev. 122: 5-36(Apr. 15, 1961).

The angular distributions of shower particles from 54 clear interactions of protons and neutrons with energies $>10^{12}$ ev in a stack of nuclear emulsions are analyzed. The ethod consists essentially in normalizing the angular stributions of all events in the $x = \log \tan\theta$ scale to the me dispersion σ. One finds a very significant deviation om the normal distribution predicted by hydrodynamical odels. The deviation goes in the direction indicated by e two-center model (two maxima in the plot over the x ordinate). The correlation between the separation of the o emitting centers and σ is also in qualitative agreement th the model. The angular distribution in the rest system of the emitting centers is found to be roughly isotropic. he two-center model also offers an explanation for certain characteristic features observed for the angular distribution of events with a small number of shower particles ($n_s \leqq 5$). On the basis of this model a coefficient of inasticity of ≈0.2 is obtained for these events. Interactions haracterized by small evaporation ($N_h \leqq 5$) and small numbers of shower particles ($n_s \leqq 20$) show the characteristic vo-maximum shape. The same shape is found for predominably central collisions with heavy nuclei in the emulsion ($N_h > 8$, $n_s > 40$). However, the group of collisions ith $N_h \leqq 5$, $n_s > 20$ does not show the two maxima. The ast two observations cannot be explained by the present imple form of the two-center model. (auth)

6297 COSMIC-RAY AIR SHOWERS AT SEA LEVEL. . W. Clark, J. Earl, W. L. Kraushaar, J. Linsley, B. B. ossi, F. Scherb, and D. W. Scott (Massachusetts Inst. of ech., Cambridge). Phys. Rev. 122: 637-54(Apr. 15, 1961).

An investigation at sea level of cosmic-ray showers with izes from 5×10^5 to over 10^9 particles is described. The ore locations, arrival directions, and particle density distributions of several thousand showers whose cores landed within an area of 10^5 m^2 were determined by the techniques of fast-timing and density sampling. The most important results are as follows: (1) The existence of primary particles with energies greater than 10^{18} ev is established by the observation of one shower with more than 10^9 particles. (2) The function $f(r) = 0.45\ (N/R_0^2)r^{-0.7}\ (1+r)^{-3.2}$, where $r = R/R_0$ and $R_0 = 79$m, describes the lateral distribution of particles at distances in the range 50 m < R < 400 m and for showers with sizes in the range $5 \times 10^5 < N < 10^8$. (3) At distances greater than 50 m from the core the density fluctuations in individual showers have a Poisson distribution. (4) The size and zenith angle distribution can be represented by the formula $s(N,x) = s_0(10^6/N)^{\Gamma+1} \exp[-(x-x_0)/\Lambda]$, where $x = x_0 \sec\theta$, $x_0 = 1040$ g cm^{-2}, $s_0 = (6.6 \pm 1.0) \times 10^{-8}$ cm^{-2} sec^{-1} sterad^{-1}, $\Gamma = 1.9 \pm 0.1$, $\Lambda = (113 \pm 9)$ g cm^{-2}, $x_0 < x < 1.3x_0$, and $7 \times 10^5 < N < 7 \times 10^8$. (5) No evidence is found of anisotropy in the arrival directions or of a break in the energy spectrum of the primaries up to the largest energies observed. (6) Assuming a specific model for shower development and taking into account fluctuations in the depth of the first interaction, the integral energy spectrum of the primaries is $J(E) = J_0(10^{15}/E)^{\gamma}$, where $J_0 = (8.1 \pm 3.1) \times 10^{-11}$ cm^{-2} sec^{-1} sterad^{-1}, $\gamma = 2.17 \pm 0.1$, and 3×10^{15} ev < E < 10^{18} ev. (auth)

16298 HIGH-ENERGY X RAYS DURING SOLAR FLARES. J. I. Vette and F. G. Casal (Convair Scientific Research Lab., San Diego, Calif.). Phys. Rev. Letters, 6: 334-6(Apr. 1, 1961).

X-radiation was measured coincidently with other cosmic radiation from solar flares observed on Oct. 12, 1960. Measurements were taken from a balloon that reached a peak altitude of 1.2×10^5 ft. Two events were recorded on the x-ray scintillation counter, one at 1730 UT and the other at 1747 UT. Sudden enhancements of atmospherics, sudden cosmic noise absorptions, and radio noise storms that occurred during this time period were described. (T.F.H.)

16299 SATELLITE DETERMINATION OF HEAVY PRIMARY COSMIC-RAY SPECTRUM. M. A. Pomerantz (Bartol Research Foundation, Swarthmore, Penna.), P. Schwed and H. Hanson. Phys. Rev. Letters, 6: 362-4 (Apr. 1, 1961).

The flux of heavy nuclei ($Z \geq 6$) in cosmic radiation was measured by the satellite Explorer VII (1959 Iota). The data provided values of the exponent, γ, in the integral magnetic rigidity spectrum expressed the form $N(>pc/Ze) = k(pc/Ze)^{-\gamma}$. The altitude of Explorer VII varied between 530 and 1100 km. The γ values were found during the periods from Oct. 13 to 24, 1959 and from Apr. 13 to 20, 1960. (T.F.H.)

16300 ON THE STRUCTURE OF EXTENSIVE AIR SHOWERS. [PART] II. Akira Ueda (Univ. of Sydney). Progr. Theoret. Phys. (Kyoto), 24: 1231-61(Dec. 1960). (In English)

The structure of extensive air showers (EAS) is examined in detail, in particular in its dependence upon the characteristics of the high-energy nuclear interactions and the primary energy spectrum. The following effects are taken into account: (1) The fluctuation in the depth at which the primary particles make their first interaction. (2) The fluctuations in the first interaction made by heavy primary particles. The main results are summarized as follows: (i) Shower curves are derived which are consistent with experiments, by a proper choice of the parameters of a model high-energy interaction. (ii) Under the assumptions that the relative abundance of various groups of primary nuclei at the top of the atmosphere is the same as measured at lower energies and that all groups have the same energy spectra as the proton spectrum, the calculated shower size spectrum is not inconsistent with that observed, even if there is a cutoff in the primary energy at about 5×10^8 Mc^2 per nucleon. (iii) Under the same assumptions, the fluctuation in the ratio between numbers of muons and electrons is, at sea level, almost entirely governed by the fluctuation in the depth of the first interaction of protons. At mountain altitudes the fluctuation in the ratio is governed nearly equally by both the fluctuations due to protons and that due to heavy nuclei. (iv) Under the same assumptions, the shower rate due to primary nuclei heavier than protons is, at mountain altitude, equal to or greater than twice that due to protons. (v) There is a possibility that high-energy nuclear active particles ($\gtrsim 10^{12}$ ev) in EAS initiated by a proton are as abundant as those in an EAS initiated by a heavy nucleus. Additional remarks which would be useful for further investigations are also given. (auth)

16301 VARIATIONS IN INTENSITY OF COSMIC RADIATION DURING MAGNETIC STORMS WITH A SUDDEN AND GRADUAL COMMENCEMENT. A. I. 01. Solnechnyie Dannye, No. 2, 68-71(1959).

Variations in cosmic-ray intensity during magnetic storms were investigated by the epoch superposition method, using mean daily values of cosmic meson intensities taken from Apr. 1937 to Dec. 1946 at Godhaven, Chaltnam, Wankayo, and Christchurch. During suddenly com-

mencing storms, cosmic radiation intensity was found to decrease by 0.7%, while during gradually commencing storms, the intensity remained constant within 0.2%. Measurements were taken during the IGY at Heuss Island, Moscow, Berkeley, and Zugspitye. During suddenly commencing storms, an intensity decrease of 2.0% was observed, while during gradually commencing storms, an intensity increase of almost 1% was found. The IGY measurements included neutron intensities. Possible solar origins of the intensity fluctuations were discussed. (TCO)

Criticality Studies

16302 (AERE-M-802) ESTIMATED DENSITIES OF PLUTONIUM AND HYDROGEN FOR USE IN CRITICALITY CALCULATIONS. E. E. Jackson and E. Wait (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Dec. 1960. 5p.

A compilation was made of plutonium and hydrogen densities in solid plutonium compounds for which x-ray or optical crystallographic data were available. Methods of estimating the densities are discussed. The densities given are expressed as the weight of plutonium or hydrogen in a unit volume of the material. The densities of the compounds themselves are also given and the way in which the density was derived is indicated. (M.C.G.)

16303 (HW-SA-2109) NEUTRON MULTIPLICATION MEASUREMENTS OF HETEROGENEOUS 3.1 PER CENT ENRICHED URANIUM - WATER SYSTEMS. R. C. Lloyd, R. B. Smith, and E. D. Clayton (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 28, 1959. 16p.

A series of approach-to-critical type experiments were conducted to obtain information needed for the design of efficient systems for processing spent power reactor fuel elements. The series included experiments such that the lattice spacings spanned maximum buckling and minimum critical mass. Maximum buckling and minimum critical mass data are tabulated for the three fuel rod sizes tested. (B.O.G.)

16304 (KAPL-M-SIB-1) PROMPT NEUTRON DECAY CONSTANTS IN MULTIPLYING HYDROGENEOUS MEDIA. D. R. Bach, S. I. Bunch, R. J. Cerbone, and R. E. Slovacek (Knolls Atomic Power Lab., Schenectady, N. Y.). Dec. 1960. Contract W-31-109-eng-52. 36p.

The pulsed neutron technique for measurements in multiplying hydrogeneous media is discussed. Measurements were made on assemblies whose k_{eff} was 0.2 to 1.0 where subcriticality was effected by reducing the physical size from the critical size rather than by inserting poison. The decay constants were calculated using the 1/v poison removal method, and the results are compared with measurements. Preliminary integral-type measurements of the neutron spectrum which exists in the assembly during the decay of the neutron pulse were obtained. These indicate that the spectrum is extremely "diffusion cooled." A crude two-group calculation relates the decay constant to a spectral difference between the steady state and decaying state and indicates that the decaying-state spectrum should be softer than the steady-state spectrum. The limitations and possible applications of measurements in the far subcritical region are discussed. (auth)

Elementary Particles and Radiations

16305 (AFOSR-TN-60-1084) UNITARITY AND THE MANDELSTAM REPRESENTATION. Technical Scientific Note No. 12. R. W. Lardner (Cambridge Univ., England). July 1960. Contract AF61(052)-233. 16p. (AD-244246)

The three-particle terms in the unitarity expansion fo scattering amplitude were examined on the assumption t the relevant production amplitudes satisfy single dispers relations. It is shown that they satisfy the Mandelstam representation. The proof was extended to the four-parti terms. (auth)

16306 (JINR-D-584) ANALYSIS OF EXPERIMENTA DATA ON THE TOTAL CROSS SECTIONS FOR PION-PROTON INTERACTION. N. P. Klepikov, V. A. Meshch yakov, and S. N. Sokolov (Joint Inst. for Nuclear Researc Dubna, U.S.S.R. Lab. of Theoretical Physics). 1960. 6

An interpolation formula is described, based on the hypothesis describing the behavior of scattering cross secti σ^+ and σ^-, at energies from zero to infinity. All the resonance states were checked for asymmetry, which was fou to be significant only for the main resonance P_{33}, $T = 3/2$, and equal to zero for all others. The best values of the parameters, α, which were varied in the interpolation formula, and their errors were found by the method of lea squares adapted to solving problems with many non-linear parameters. Cross section values, $\sigma^+(E)$ and $\sigma^-(E)$, which are in best agreement with experimental results are show graphically for energies from 0 Mev to 6 Bev. A discussic is given of the use of the analytical expressions for $\sigma^{\pm}(E)$ for checking the dispersion relations for the forward π-p scattering. (B.O.G.)

16307 (JINR-D-648) PRODUCTION OF NEUTRAL PIONS IN PROTON COLLISIONS WITH COMPLEX NUCLE A. F. Dunaitsev and Yu. D. Prokoshkin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Prob lems). 1961. 11p.

The angular distributions are given of gamma quanta from the decay of mesons-π^0 produced by 660-Mev protons on D, Li^6, Li^7, C^{12}, O^{16}, Al^{27}, Cu^{64}, Sn^{119}, and Pb^{202}. The angular distributions were used to determine total cross section values for the production reactions. The energy dependence of the π^0-production total cross section on carbon on the energy of bombarding protons is given from 175 to 660 Mev. (B.O.G.)

16308 (ML-734) RADIATION FROM RELATIVISTIC ELECTRONS. Final Report, June 15, 1956 to June 30, 196 Kenneth B. Mallory (Stanford Univ., Calif. Microwave Lab.). July 1960. Contract DA-36-039 SC-72785. 41p. (AD-245585)

The bunched output beam of a 3.5-Mev, X-band, electron linear accelerator was used to investigate the properties of certain structures at millimetric and submillimetric wavelengths. With sinuous waveguides and magnetic undulators, the effective bunch size was found to be about 7°. Signals were obtained at wavelengths as short as 0.60 mm. A 3-ma beam produced 1 milliwatt of power at 1 millimeter wavelength. The signals could be increased by improving the rf source and the electron injection system for the accelerator (auth)

16309 (NP-9910) RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM. Fourth Quarterly Progress Report, September 16, 1960—December 15, 1960. R. Novick (Columbia Univ., New York. Columbia Radiation Lab.). Dec. 15, 1960. Contract DA-36-039 SC-78330. 55p. (CU-12-60-SC-78330-Phys.).

The production of 2.6-mm magnetrons is described. A description of several maser projects and paramagnetic resonance experiments is given; in particular, molecular beam spectroscopy, the measurement of relaxation times

low temperatures, and a new "double maser" technique increasing spectrometer sensitivity. A preliminary ue for the dipole moment of the OH radical is reported. ta taken with a 21-cm maser radioastronomy system are ng analyzed. Optical oscillation of a pulsed ruby maser s observed. A number of projects involving atomic beams e described, including the measurement of hyperfine tran- ions of Kr^{83}. An experiment was undertaken to study the eraction between a beam of neutral atoms and a plane nducting surface. Several optical double resonance ex- riments are described, including the measurement of the in and moments of Cd^{109}. A paramagnetic spectrometer th optical detection, capable of extreme sensitivity, is der construction. (auth)

310 (TID-12119) STUDIES OF THE PROPERTIES ELEMENTARY PARTICLES WITH BUBBLE CHAM- ERS AND OTHER TECHNIQUES. Technical Progress eport, June 1, 1960–May 31, 1961. Daniel Sinclair Michigan. Univ., Ann Arbor. Coll. of Literature, Sci- ce, and the Arts). Mar. 1961. Contract AT(11-1)-363.). (ORA-03931-3-P)

Data obtained in the course of an exposure of the xenon ubble chamber to 1.1 Bev/c mesons (π^-) were analyzed. he branching ratios of Λ and K^0 particles from decay into eutral secondaries were measured. The sign on the Λ de- ay asymmetry was found to be negative. Analysis of 0,000 pictures obtained when the bubble chamber was ex- osed to a separated 800 Mev/c K^+ beam is in progress. he mass of the K_2^0 particle was found to be 496.8 ± 2.5 lev. The xenon chamber was also exposed to a separated $^+$ beam at 400 Mev/c and the data obtained are being nalyzed. A search for the reaction $\mu^+ + e^- \rightarrow \mu^- + e^+$ was ndertaken and an upper limit of the order of a few per 00,000 stopping mesons was obtained. The gold-doped ilicon detector was used to measure the energy-loss luctuations in silicon of 1.5 and 2.55 Bev/c mesons (π^-). M.C.G.)

16311 (USASRDL-TR-2154) FERMI-DIRAC FUNC- TIONS OF INTEGRAL ORDER. Phillip A. Newman, Jr. (Army Signal Research and Development Lab., Fort Mon- mouth, N. J.). Sept. 1, 1960. 10p. (AD-246077)

Fermi-Dirac functions are used in the theoretical treat- ment of assemblies of particles (electrons) subject to Fermi-Dirac statistics. These functions are required in treating the equilibrium, magnetic, and thermal properties of assemblies of electrons for certain distributions of en- ergy states. For the treatment of such transport effects as the electrical and thermal conductivity and for a few other applications, Fermi-Dirac functions of integral order are required. These functions were previously calculated for limited values of η and published in a form difficult to use. The integrals were calculated over a wider range of η from a direct digital computation of the integral. (auth)

16312 (JPRS-3571) MEASUREMENT OF THE ENERGY OF FAST IONS IN A POWERFUL PULSED DISCHARGE. B. G. Brezhnev. Translated from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Energet. i Avtomat., No. 2, 54-8(1960). 8p. (OTS-60-31414)

The energies of fast ions from a pulsed discharge in deu- terium were measured by the Thomson parabola method. The apparatus and techniques are described. Measurements of the velocities of the deuterons flying from the plasma perpendicular to the axis of the discharge showed that scarcely noticeable traces of parabolas were obtained by exposing photographic plates for 80 to 100 pulses. The stream of particles was markedly larger in experiments with beams of charged particles flying along the discharge and passing through the aperture in the cathode. It was determined that the fast ions in the plasma produced by a powerful pulsed discharge in deuterium and hydrogen had a continuous spectrum with velocities ranging from 4 to 200 kev. The presence of deuterons with energies five times those of the discharge voltage indicated the appearance of accelerating processes in the discharge. It was found that neutron radiation during discharge in deuterium is caused chiefly by these accelerating processes in the plasma fila- ment. (M.C.G.)

16313 QUANTITY AND QUALITY OF SCATTERED X RAYS. J. H. Martin and Gwenda M. Muller (Cancer Inst., Melbourne). Brit. J. Radiol., 34: 227-35(Apr. 1961).

Measurements are presented of the amount and quality of radiation scattered from materials of different atomic numbers. At all energies of the primary x-ray beam used, low atomic number materials scatter the greatest quantity of radiation, the differences in the normal deep therapy range being large. The quality of the radiation scattered shows a maximum for scatterers of medium atomic num- ber in this energy range and a steady increase with atomic number at the highest energy used. (auth)

16314 UNKNOWN PARTICLES. [PART] I. P. Renson (Université, Liège). Bull. classe sci., Akad. roy. Belg. (5), 46: 468-74(1960). (In French)

The possible existence of undiscovered elementary par- ticles is discussed. The electric charge Q and the "neu- trinonic charge" R previously are given for two such par- ticles, which are baryons: Q = 1, R = 0 and Q = −1, R = −2; for the newly discovered D-meson, they are Q = 1, R = 1. (auth)

16315 THE GREEN'S FUNCTION OF THE LIOUVILLE EQUATION. Frank C. Andrews (Université Libre, Brus- sels). Bull. classe sci., Akad. roy. Belg. (5), 46: 475-85 (1960). (In French)

The Green's function for the Liouville equation is de- veloped by an inverse operator technique, and several special cases of the general function are analyzed. Using the same technique, the n-body interaction was developed to determine the validity of replacing f_n, the distribution function (D.F.) of the n bodies during or after their inter- action, by the asymptotic form of the D.F. for the n parti- cles calculated at the particle positions and momenta be- fore their interaction. This replacement is found to be strictly valid. (auth)

16316 UNKNOWN PARTICLES. [PART] II. Pierre Renson (Université, Liège). Bull. classe sci., Acad. roy. Belg. (5), 46: 609-20(1960). (In French)

The X and Y particles predicted in part I have presum- ably masses of about 2150 and 2900 m_e, respectively. They may decay respectively into a nucleon and a Ξ hyperon by emitting a pion; lifetimes of the order of 10^{-10} sec may be expected (weak interactions). The mass of the D meson is about 1670 m_e, and it decays into a K meson and one or two pions. Leptonic modes of decay are also possible. The di- mension 3 of the charge-space introduced previously is confirmed. The correlations considered are re-examined. (auth)

16317 APPLICATION OF THE METHOD OF QUASI- REAL PROCESSES TO THE PRODUCTION OF INTERNAL PAIRS. Paul Kessler. Compt. rend., 252: 994-6(Feb. 13, 1961). (In French)

The method of quasi-real processes is used to consider the phenomenon of internal pair creation, particularly in the decay of the π^0 meson and in the capture of the π^- meson in hydrogen. (tr-auth)

16318 THE YANG AND MILLS FIELD. Pierre Hillion and Jean-Pierre Vigier. Compt. rend., 252: 1113-15 (Feb. 20, 1961). (In French)

It is shown that the Yang and Mills field does not possess self-mass, but that there is a coupling energy between the three vector components of this field. (tr-auth)

16319 A PHENOMENOLOGICAL THEORY ANALYSIS OF THE INTRINSIC MASS OF ELEMENTARY PARTICLES. Olivier Costa de Beauregard. Compt. rend., 252: 1276-8 (Feb. 27, 1961). (In French)

A numerical argument has been produced (Compt. rend. 252, 849(1961)) which strongly suggests that the quantization of intrinsic masses of elementary particles implies three mass quanta: leptic m_l (electron mass), mesic m_0 ($^3/_2$ mass of meson), and baric m_b (proton mass). These quanta are themselves biunequivocally bound to the coupling constants e^2, $\hbar c$, and g^2 of the electromagnetic, gravitational, and mesic fields. In the present study, an interpretative discourse is presented attempting to justify this relationship between the mass quanta and the coupling constants, a relationship implicating the quantum of length l defined relative to m_0 and equal to the "classical radius of the electron": $c^2 l = e^2/m_l = \hbar c/m_0 = g^2/m_0$. (J.S.R.)

16320 EXTENSION OF THE METHOD OF QUASI-REAL PROCESSES TO BOSON-PHOTON INTERACTIONS. Paul Kessler. Compt. rend., 252: 1279-81(Feb. 27, 1961). (In French)

The method of quasi-real processes is extended to Feynman diagrams having a photon and two boson states (relativistic). Three cases are considered: virtual photon, virtual exiting boson, and virtual entering boson. (J.S.R.)

16321 ON THE STATISTICAL THEORY OF MIXED ION–DIPOLE SYSTEMS OF INTERACTING PARTICLES. I. R. Yukhnovskii (L'vov State Univ.). Doklady Akad. Nauk S.S.S.R., 136: 1317-20(Feb. 21, 1961). (In Russian)

A generalization is developed for applying the method of collective variables to the system with non-central interactions. The N ion system of M variety, with N_a particles in each variety of a and S dipoles characterized by a constant dipole moment $m(\vartheta\varphi)$, is analyzed. The free energy of an equilibrium system with a given potential is sought, omitting the kinetic part. (R.V.J.)

16322 ON THE NUCLEAR INTERACTION OF MU-MESONS. Hiroyuki Shibata (Osaka City Univ.). J. Phys. Soc. Japan, 16: 372-7(Mar. 1961). (In English)

The penetrating showers observed with a large multiplate cloud chamber underground are analyzed. The frequencies of the penetrating showers that are experimentally verified to be produced by μ-mesons are interpreted with the Williams-Weiszäcker method and the constant photonuclear cross section of 1.4×10^{-28} cm^2/nucleon. It is shown that the angular distribution of secondary penetrating particles in multiple productions produced by μ-mesons is nearly isotropic in the center-of-mass system of the target nucleon and photon which is virtually associated with the incoming μ-mesons. (auth)

16323 ON THE STRUCTURE OF THE FOUR POINT FUNCTIONS IN HEISENBERG'S NON-LINEAR SPINOR THEORY. E. Montaldi (Max-Planck-Institut für Physik und Astrophysik, Munich). Nuclear Phys., 23: 439-51 (Mar. 1961). (In English)

The vacuum expectation value of a product of four Fermi field operators is investigated within the framework of Heisenberg's non linear spinor theory of elementary particles. It is shown that a spectral representation still enjoying all the symmetry properties of the fundamental equation can be constructed. This representation is characterized by only two independent mass spectra, which satisfy various symmetry requirements. Their connection with the mass spectrum of the two point function is also briefly discussed. (auth)

16324 EMISSION OF FAST PARTICLES IN A HETEROGENEOUS MEDIUM. M. L. Ter-Mikaelyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Nuclear Phys., 24: 43-61(1961). (In English)

The radiation arising in the passage of relativistic particles of constant velocity through an arbitrary periodic heterogeneous medium is discussed. The necessary condition of the origin of radiation, the condition of resonance, is derived on the basis of the laws of conservation of energy and momentum. The total radiation in a periodic medium is composed of radiations of different orders (harmonics). For each order of radiation there is a special frequency interval and its own energy threshold. The radiation of each order is concentrated around the lower boundary of the respective spectrum intervals. The intensity of resonance radiation and its spectrum are calculated (a) for a medium changing its properties by the cosine law, (b) for a medium of arbitrary periodicity with a weak change of density, and (c) for a stratified medium, probably the most suitable for experimental purposes. Different effects influencing the accuracy of the formulas derived are analyzed. The properties of resonance radiation enumerated above can be applied in the physics of particles of ultra-high energy. (auth)

16325 ON ISOBARIC EXCITATION OF NUCLEONS IN COLLISIONS WITH FAST PARTICLES. V. V. Glagolev, V. Petržílka, and K. D. Tolstov (Joint Inst. for Nuclear Research, Dubna, USSR). Nuclear Phys., 24: 126-31(1961). (In English)

An analysis is made of the possible contribution of isobaric states to collisions of nucleons with nucleons of momentum 10 Bev/c and π^- mesons of momentum 7 Bev/c. In both cases the excitation energy in the center-of-mass system is identical. The contribution of the isobaric states produced in the isotropic decay of an isobar with 1.24 Bev mass is shown to be small. (auth)

16326 THE $C^{13}(d,n)N^{14}$ REACTION. A. N. James (Cavendish Lab., Cambridge, Eng.). Nuclear Phys., 24: 132-7(1961). (In English)

The time-of-flight method was used to measure angular distributions and excitation functions for the neutrons emitted to form the ground and first six excited states of N^{14} in the $C^{13}(d,n)N^{14}$ reaction. The properties of the 4.91 and 5.69 Mev N^{14} levels were consistent with the weak coupling configuration ($C^{13}2s_{1/2}$). The nature of the 5.10 and 5.83 Mev levels remains in doubt. (auth)

16327 ELASTIC PHOTOPRODUCTION OF NEUTRAL PIONS FROM DEUTERIUM. Alladi Ramakrishnan, V. Devanathan, and G. Ramachandran (Univ. of Madras). Nuclear Phys., 24: 163-8(1961). (In English)

The elastic photoproduction of neutral pions from deuterium was studied under the impulse approximation using the Chew-Low amplitude for the photoproduction of π^0 from nucleons. The differential cross sections were obtained at various photon energies (1.5, 2.0, and 2.5 in units of pion mass), and they are in good agreement with the available experimental values. Studies of the final spin state of the deuteron were also made. (auth)

16328 π^- + p ELASTIC SCATTERING AT 1200 Mev. L. Bertanza, R. Carrara, A. Drago, P. Franzini, I. Mannelli, G. V. Silverstrini, and P. H. Stoker (Università, Pisa, Italy and Istituto Nazionale di Fisica Nucleare, Pisa, Italy). Nuovo cimento (10), 19: 467-81(Feb. 1, 1961). (In English)

A bubble chamber investigation of π^- + p elastic scattering at 1200 Mev is reported. The total and differential cross-sections are determined. By extrapolation of the angular distribution, the 0° cross-section is derived and compared with the results obtained with the dispersion relations and the optical theorem. The forward peak is investigated in terms of diffraction scattering and a value for the optical radius is derived. (auth)

16329 COULOMB PHOTOPRODUCTION OF π^0 AT HIGH ENERGY AND π^0 LIFETIME. C. Chiuderi (Università, Florence) and G. Morpurgo. Nuovo cimento (10), 19: 497-511(Feb. 1, 1961). (In English)

The possibility is suggested of determining the lifetime of the π^0 meson using π^0 photoproduction in a Coulomb field. Competition with coherent nuclear production necessitates a rather high photon energy. Even at 1 Bev, the Coulomb photoproduction dominates over the coherent nuclear one only in a very narrow cone around the forward direction. It must be shown further that the incoherent production is not dominant in this cone. Though the incoherent production is certainly smaller than the coherent nuclear one by a factor of A (= mass number), the incoherent cross section does not have the factor $\sin^2\theta$ which affects both the Coulomb and the nuclear coherent cross sections. A calculation of the incoherent photoproduction of π^0 at small angles is therefore made using a multipole expansion and sum rules. It is shown that, for lead, the incoherent cross section at small angles is at most of the same order of magnitude of the nuclear coherent one so that it does not dominate the picture. For light nuclei the competition between incoherent and coherent nuclear production at small angles is more unfavorable and depends rather critically on the properties of the individual nucleus chosen. It is concluded that heavy nuclei are the most suited for this experiment and that, at 1 Bev, only lifetimes shorter than $\sim 10^{-16}$ may be measured by this method. (auth)

16330 NOTES ON THE STATIC PARITY NON-CONSERVING INTERNUCLEON POTENTIAL. G. Barton (Inst. for Advanced Study, Princton, N. J.). Nuovo cimento (10), 19: 512-27(Feb. 1, 1961). (In English)

For a weak Langrangian density $\mathcal{L}$ consisting of self-interacting charged currents, the insertion into $\mathcal{L}$ of a term linear in the pion field leads to a static parity non-conserving internucleon potential V, the general order of magnitude of whose effects no longer depends on the quadratic pion terms needed for the conservation of the vector current. If neutral currents also contribute to $\mathcal{L}$ in such a way as to make it an isotopic scalar, the inclusion of linear pion terms has no effect on V, which then remains inappreciable unless the vector current is conserved. The origins of such pion terms are discussed; it is found that as a consequence of time reversal invariance, V cannot contain contributions arising from the exchange of a single pion. (auth)

16331 CLOSED FORMULAE FOR THE STATISTICAL WEIGHTS. F. Cerulus (Institut Interuniversitaire des Sciences Nucléaires, Belg. and CERN, Geneva). Nuovo cimento (10), 19: 528-36(Feb. 1, 1961). (In English)

The branching ratios between the different charge distributions of mesons emerging with a given multiplicity from a high-energy collision are computed from isospin conservation and a statistical hypothesis on the probability of the possible end states. The method uses the Wigner-type of projection operator in group space and yields a closed formula, which is entirely general, for the weights of the different charge states. The formula is simple in the case of n isospin 1 particles coupled to a low total isospin. Cases with n isospin 1 particles and one or two isospin ½ particles are related to the former result. (auth)

16332 INTERACTIONS OF 1.16 GeV/c K^- IN NUCLEAR EMULSIONS. M. Baldo-Coelin, A. Caforio, F. Farini, A. Ferilli, and G. Miari (Università, Bari, Italy; Università, Padua; and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo cimento (10), 19: 597-9(Feb. 1, 1961). (In English)

An Ilford G-5 emulsion is exposed to a beam of K^- mesons of 1.16 Bev/c. 225 interactions of K^- mesons with emulsion nuclei are observed. Probabilities are suggested for cases in which the interacting K^- is re-emitted ($\simeq$0.2), in which a $\Sigma^\pm$ is produced ($\simeq$0.15), in which a π meson is produced without K^- meson absorption ($\geq$0.2), and in which a Ξ hyperon is produced ($\sim$0.005). (T.F.H.)

16333 $\Sigma^0-\Lambda^0$ RELATIVE PARITY FROM Σ^0 DECAY. Louis Michel and Houchangue Rouhaninejad (Laboratoire de Physique Theorique et Hautes Energies, Seine et Oise, France). Phys. Rev., 122: 242-52(Apr. 1, 1961).

In order to establish how ϵ, the $\Sigma^0-\Lambda^0$ relative parity, can be measured from actual bubble chamber experiments featuring polarized Σ^0 production and decay, followed by Λ^0 decay and γ-pair production or Dalitz pair in the Σ^0 decay, we constructed a correlation function depending on ϵ, another unknown parameter to be measured in the same experiment, and the energy and momenta of the different particles involved. Our study is Lorentz covariant, but the link with the usual "nonrelativistic" formalism is exhibited. In an Appendix it is shown that the polarization of Σ^0 produced in $\pi^- + p^+$ reactions is expected to be large. (auth)

16334 RELATIVISTIC PARTICLE SYSTEMS WITH INTERACTION. Leslie L. Foldy (Case Inst. of Tech., Cleveland). Phys. Rev., 122: 275-88(Apr. 1, 1961).

The possibility of covariantly describing a system of a fixed number of particles interacting directly is explored by attempting a direct "integration" of the commutation relations for the inhomogeneous Lorentz group under restrictions appropriate to the term "system of a fixed number of particles." By direct interaction is meant the fact that interaction between the particles is expressed directly in terms of coordinates, momenta, and spins for the particles rather than through the agency of a mediating field. The integration is carried out in considerable generality with the assumption that the infinitesimal generators of the group have expansions in inverse powers of the square of the velocity of light. The result coincides with that obtained earlier by Bakamjian and Thomas, but the method employed yields greater insight into the generality of the result, as well as into how further conditions beyond covariance, such as the property which is here called "separability of the interaction," can be incorporated in the result. The relationship of the result to the complete reducibility of a representation of the inhomogeneous Lorentz group is pointed out. Possible generalizations and applications of the procedures here employed are discussed. (auth)

16335 INTERNAL SYMMETRIES OF STRONG BARYON-MESON INTERACTIONS. Yoshio Shimamoto (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 122: 289-97 (Apr. 1, 1961). (BNL-5046)

A simple model considered previously by Pais in which the Σ and Λ hyperons are regarded as a mass-degenerate supermultiplet in the strong pion interaction is reconsidered. It is shown that recognition of the symmetry exhibited by these hyperons in their pionic coupling leads to certain prescriptions which may be used to break the symmetry

via the strong K-meson interactions. The symmetry reduction schemes described make possible the construction of a strong baryon-meson interaction Hamiltonian which requires no more than four coupling constants (rather than the customary eight) and which in no way imposes severe restrictions on the strong interactions. Finally, production and scattering amplitudes based on the 4-symmetry are discussed. (auth)

16336 EFFECTS OF K-MESON INTERACTIONS ON THE NUCLEON ANOMALOUS MAGNETIC MOMENT. K. Nishimura (Rutgers Univ., New Brunswick, N. J.). Phys. Rev., 122: 312-16(Apr. 1, 1961).

A previous calculation of the physical nucleon wave function in static source pion theory is extended by including the pseudoscalar K-meson interactions, the motivation being that this should increase the scalar part of the nucleon anomalous magnetic moment, thus improving the result of previous calculations. In constructing a trial function for the physical nucleon, the method of moments was used and terms containing up to three mesons were included. Calculation shows that a too strong K-meson coupling is detrimental to the vector part, and that the scalar part can be increased approximately by 10% if the K-meson interaction is made moderately low. (auth)

16337 THEORETICAL ASPECTS OF NONLEPTONIC HYPERON DECAYS. A. Pais (Univ. of California, Berkeley). Phys. Rev., 122: 317-30(Apr. 1, 1961). (UCRL-9460)

Recent experimental results on nonleptonic hyperon decays are studied on the basis of a doublet approximation for strong and weak interactions, with the implied suggestion that this higher symmetry may be more easily discernable in such reactions in which K-particles do not occur explicitly. The doublet approximation is characterized by a doublet spin I which is equal to $\frac{1}{2}$, 1, 0 for baryons, π, K, respectively, and by a K spin. It is not necessary to assume that the strong K interactions are weak compared to the strong π interactions. For the mentioned reactions it is necessary to assume that the strong interactions which do not conserve I play a minor role compared to those which conserve I. The following refinement of the nonleptonic $\Delta T = \frac{1}{2}$ rule is proposed. (T = isotopic spin.) The weak nonleptonic interactions consist of two parts $H^{(0)}$, $H^{(1)}$ with $\Delta I = 0, 1$, respectively. In the doublet approximation $H^{(0)}$ and $H^{(1)}$ separately conserve parity in the presence of all strong π and K interactions. $H^{(0)}$ and $H^{(1)}$ together do not conserve parity, however. In addition to $\Delta I = 1$, $H^{(1)}$ should in general satisfy a further constraint, but there are classes of graphs for which $\Delta I = 1$ is sufficient. Current × current structures for $H^{(0)}$ and $H^{(1)}$ are examined. Results of an earlier paper can be viewed as a special case of the $\Delta I = 0, 1$ rule. The same is true for results obtained by Feldman, Matthews, and Salam and by Wolfenstein. The considerations of these authors can be extended to wider classes of graphs. Odd relative helicity and the relation between rates for $\Lambda \rightarrow p + \pi^-$, $\Sigma^+ \rightarrow p + \pi^0$ are consequences of the $\Delta I = 0, 1$ rule only. So is the prediction that Ξ decay is strongly P nonconserving. The parity properties of $H^{(0)}$, $H^{(1)}$ are sufficient conditions. It is a delicate question whether they are necessary. For a subset of graphs they are not necessary, but this set seems arbitrary. If it is assumed that the parity conditions are necessary, the schizon scheme is ruled out. It is noted that the nonleptonic weak interactions may be generated by the strong interactions in terms of the following prescription. $H^{(1)}$ is generated by assuming that the π(K) fields have small K(π) components. An $H^{(0)}$ is generated by assuming that the doublets $N_1(N_2)$ have small $N_2(N_1)$ components; likewise fo N_3 and N_4. Further, it is observed that one can construct non-electromagnetic $\Delta T = \frac{3}{2}$ interaction which is small in the sense that it only contributes to $K_{\pi 2}$ to the extent that the doublet approximation is not valid. (auth)

16338 INTERMEDIATE VECTOR BOSON AND RADIATIVE LEPTON DECAY OF THE K MESON. Akira Kanazawa (Purdue Univ., Lafayette, Ind.), Masao Sugawara, and Katsumi Tanaka. Phys. Rev., 122: 341-4(Apr. 1, 1961).

K meson decay into electron, neutrino, and photon is analyzed in the lowest order perturbation with respect to weak and electromagnetic interactions, but without making any approximation regarding the strong interaction. The weak interaction is assumed to be transmitted by a single charged intermediate vector meson, which interacts with the weak current in the conventional way. It is pointed out here that a certain angular and momentum distribution of decay particles could reveal almost unequivocally whether the intermediate vector meson does exist. It is shown also that other lepton decays of the K meson, which includes μ mesons and π mesons, cannot be used for the same purpose. (auth)

16339 DYNAMICAL MODEL OF ELEMENTARY PARTICLES BASED ON AN ANALOGY WITH SUPERCONDUCTIVITY. [PART] I. Y. Nambu and G. Jona-Lasinio (Univ. of Chicago). Phys. Rev., 122: 345-58(Apr. 1, 1961).

It is suggested that the nucleon mass arises largely as a self-energy of some primary fermion field through the same mechanism as the appearance of energy gap in the theory of superconductivity. The idea can be put into a mathematical formulation utilizing a generalized Hartree-Fock approximation which regards real nucleons as quasiparticle excitations. We consider a simplified model of nonlinear four-fermion interaction which allows a γ_5-gauge group. An interesting consequence of the symmetry is that there arise automatically pseudoscalar zero-mass bound states of nucleon-antinucleon pair which may be regarded as an idealized pion. In addition, massive bound states of nucleon number zero and two are predicted in a simple approximation. The theory contains two parameters which can be explicitly related to observed nucleon mass and the pion-nucleon coupling constant. Some paradoxical aspects of the theory in connection with the γ_5 transformation are discussed in detail. (auth)

16340 HIGHER RANDOM-PHASE APPROXIMATIONS IN THE MANY-BODY PROBLEM. H. Suhl and N. R. Werthamer (Bell Telephone Labs., Murray Hill, N. J. and Univ. of Calif., Berkeley). Phys. Rev. 122: 359-66 (Apr. 15, 1961).

The usual random-phase approximation combined with an equations-of-motion technique for the many-electron problem is extended, yielding many of the known results of series summation methods in a straight-forward manner. The method should apply to other types of many-body problems as well. (auth)

16341 DETERMINATION OF ELECTRON AND POSITRON HELICITY WITH MOLLER AND BHABHA SCATTERING. J. D. Ullman, H. Frauenfelder, H. J. Lipkin, and A. Rossi (Univ. of Illinois, Urbana). Phys. Rev., 122: 536-48(Apr. 15, 1961).

The determination of the helicity of electrons and positrons from beta decay by means of electron-electron (Møller) and positron-electron (Bhabha) scattering is discussed. The theoretical background, the apparatus, and the experimental procedure are treated in detail. The apparatus included, in addition to the conventional parts, a beta

monochromator with a momentum resolution of 16% for the investigation of the energy dependence of the helicity. Experiments were performed with P^{32}, Au^{198}, RaE, and Ga^{68}. In all cases, the helicities P were found to be proportional to v/c. The measured helicities, in units of v/c and averaged over the observed range of energies, are summarized. (auth)

16342 ON THE NUCLEAR CAPTURE OF MUONS WITH ELECTRON EMISSION. M. Conversi, L. Di Lella, A. Egidi, C. Rubbia, and M. Toller (Università, Rome). Phys. Rev., 122: 687-95(Apr. 15, 1961).

Two experiments carried out to search for the process of muon capture with electron emission are reported. The second of the two experiments is nearly 200 times more sensitive than earlier attempts to find this capture mode, but no indication is obtained in favor of the latter. In both experiments negative muons are made to stop in copper, where coherent capture is predominant, so that the "capture electrons" should be emitted with an energy spectrum sharply peaked around 100 Mev. For the branching ratio of the process searched for, relative to ordinary muon capture, upper limits of about 5×10^{-5} and 5×10^{-6} are established through the first and second experiment, respectively. (auth)

16343 MAGNETIC MOMENTS OF THE Λ AND Σ HYPERONS. Katsumi Tanaka (Argonne National Lab., Ill.). Phys. Rev., 122: 705-11(Apr. 15, 1961).

A relation among the magnetic moments of Σ^+, Σ^0, Σ^-, and Λ is obtained as a consequence of the proposed symmetries of strong interactions, a minimal electromagnetic coupling for the electromagnetic interactions being assumed. The magnetic moments of the Λ and Σ hyperons are calculated with the aid of mass spectral representations in which only the contributions of the bound states are taken into account. The present calculation of these magnetic moments is compared with various other calculations. Remarks are made on the possible experimental values. (auth)

16344 Λ BINDING IN HYPERNUCLEI BY NONLOCAL INTERACTION. G. Rajasekaran and S. N. Biswas (Tata Inst. of Fundamental Research, Bombay). Phys. Rev., 122: 712-18(Apr. 15, 1961).

The characteristics of the Λ-N interaction at low energy were obtained assuming that the Λ-N potential is nonlocal but separable and similar to that suggested by Yamaguchi in the case of N-N potential. The unknown parameters entering in the proposed potential are determined on the basis of the global symmetry hypothesis of the strongly interacting particles. Our model predicts, in agreement with Dalitz and Downs' phenomenological findings of the nature of the Λ-N potential based on hyperfragment data, that there is no bound Λ-nucleon system and that the singlet Λ-N potential is stronger than the triplet potential, both being attractive. Binding energies of the Λ particle in light hypernuclei based on the present model are, however, much too high compared with the experimental data. It is further pointed out that although the global symmetry hypothesis ($g\Lambda_\pi = g\Sigma_\pi = gN_\pi$) supplemented by the Yamaguchi type nonlocal Λ-N potential is incompatible with the presently existing data, the restricted symmetry ($g\Lambda_\pi = g\Sigma_\pi \neq gN_\pi$) model is certainly admissible. (auth)

16345 POLARIZATION AND THE TRIPLET ELECTRON-HYDROGEN SCATTERING LENGTH. A. Temkin (National Aeronautics and Space Administration, Washington, D. C.). Phys. Rev. Letters, 6: 354-5(Apr. 1, 1961).

The triplet scattering lengths (a_t) of electrons scattered from H are calculated, using a slowly vanishing part ($\sim -r^{-2}$) resulting from the induced polarization in H atoms. This long range polarization effect yields a value of triplet scattering length $a_t = 1.74$ Bohr radii, which is nearly 10% below the uncorrected value for a_t. It is noted that this effect is much less significant in the singlet scattering. (T.F.H.)

16346 EXPERIMENTAL RESULTS ON THE π-π CROSS SECTION. Jerry A. Anderson, Vo X. Bang, Philip G. Burke, D. Duane Carmony, and Norbert Schmitz (Univ. of California, Berkeley). Phys. Rev. Letters, 6: 365-7(Apr. 1, 1961).

A total of 1275 inelastic scattering events of protons by 1.03 Bev/c π^- mesons is analyzed in order to find the π-π cross section (σ). It is found that σ peaks at ~200 mb for ω^2 (invariant mass of di-pion) ~20 to 22, with a half width of about $5m_\pi^2$. (T.F.H.)

16347 ELECTROMAGNETIC FORM FACTORS OF THE NUCLEON AND PION-PION INTERACTION. S. Bergia (Università, Bologna), A. Stanghellini, S. Fubini, and C. Villi. Phys. Rev. Letters, 6: 367-71(Apr. 1, 1961).

A model is proposed for the electromagnetic structure of the nucleon; the model is based on dispersion theory and a strong π-π interaction. The nucleon current is divided into magnetic and electric isovector and isoscalar parts. The effect of the π-π interaction is shown. It is observed that 2π and 3π resonances are not sufficient to describe the nucleon completely. Properties of the model, such as the outer positive charge for the neutron, are described. (T.F.H.)

16348 PION-PION INTERACTION IN THE PHOTOPRODUCTION OF NEUTRAL PIONS WITH POLARIZED γ RAYS. B. De Tollis (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome) and A. Verganelakis. Phys. Rev. Letters, 6: 371-4(Apr. 1, 1961).

The reaction $\gamma + p \rightarrow \pi^0 + p$ with polarized γ is studied to detect the presence of a π-π interaction. Values of $d\sigma_\Pi/d\sigma_\perp$ are found as functions of θ (c.m.) and E_γ (lab), where σ_Π and $\sigma_\perp$ are pion photoproduction cross sections parallel and perpendicular to the γ polarization plane respectively. $d\sigma_\Pi/d\sigma_\perp$ is calculated both including and omitting π-π interaction terms, and the effects of several parameter variations are discussed. (T.F.H.)

16349 CONSEQUENCE OF THE CROSSING SYMMETRY FOR A CLASS OF π-π SCATTERING DIAGRAMS. E. Kazes (Pennsylvania State Univ., University Park). Phys. Rev. Letters, 6: 374-5(Apr. 1, 1961).

An approximation in π-π interaction theory is considered, in which initial and final mesons are absorbed and created in pairs, all other processes being trivial. This approximation is combined with the crossing symmetry equations, and scattering amplitudes for I = 0, 1, 2 are derived. The s- and p-wave amplitudes are found, and it is concluded that a large positive π-π scattering length in the I = 0 state is inconsistent with experiment. (T.F.H.)

16350 K^- ABSORPTION AND THE KΣN PARITY. Richard H. Capps (Northwestern Univ., Evanston, Ill.). Phys. Rev. Letters, 6: 375-7(Apr. 1, 1961).

The reactions $K^- + p \rightarrow \pi^- + \Sigma^+$, $K^- + p \rightarrow \pi^+ + \Sigma^-$, and $K^- + p \rightarrow K^- + p$ are studied at a K^- momentum of 400 Mev/c. It is found that for the scattering angle $|\cos\theta| > 1/2$ for about 3/4 of the events; this anomalous behavior is generally assumed to result from $P_{3/2}$ interactions in the K^--p system. It is pointed out, however, that if the KΣN parity is even, the anomaly may occur in the $D_{3/2}$ K^--p state. A Σ^+ polarization experiment is suggested to clarify experimental results. (T.F.H.)

16351 ODD ΛΣ PARITY AND THE NATURE OF THE πΛΣ COUPLING. Y. Nambu and J. J. Sakurai (Univ. of Chicago). Phys. Rev. Letters, 6: 377-80(Apr. 1, 1961).

Experiments are indicated that support an odd ΛΣ parity. It is shown that the scalar πΛΣ coupling can be expressed as a function of the masses of π, Λ, and Σ. Under the assumption of ΛΣ odd parity, the πΛΣ coupling results are clarified. (T.F.H.)

16352 LAW OF CONSERVATION OF MUONS. G. Feinberg (Columbia Univ., New York) and S. Weinberg. Phys. Rev. Letters, 6: 381-3(Apr. 1, 1961).

A multiplicative selection rule for μ meson-electron transitions is proposed. A "muon parity" = −1 is considered for the muon and its neutrino, while the "muon parity" for all other particles is +1. The selection rule then states that (−1) exp [no. of initial (−1) parity particles] = (−1) exp [no. of final (−1) parity particles]. Several reactions that are forbidden by an additive law but allowed by the multiplicative law are suggested; these reactions include $\mu^+ \rightarrow e^+ + \nu_\mu + \bar{\nu}_e$, $e^- + e^- \rightarrow \mu^- + \mu^-$, and muonium → antimuonium ($\mu^+e^- \rightarrow \mu^-e^+$). An intermediate-boson hypothesis is suggested. (T.F.H.)

16353 SPIN OF THE K′. Chia-Hwa Chan (Imperial Coll. of Science and Tech., London). Phys. Rev. Letters, 6: 383-5(Apr. 1, 1961).

An unstable particle K′, produced by K-π interaction, is postulated on the basis of high energy K-N interaction data. The spin properties of the K′ are studied by the interactions $K^- + p \rightarrow K'^- + p \rightarrow \bar{K}^0 + \pi^- + p$ and $\pi^- + p \rightarrow K^0 + \Lambda^0$. The K′ is found to exhibit vector boson properties. (T.F.H.)

16354 CLASSIFICATION SCHEMES FOR ELEMENTARY PARTICLES. Białkowski Grzegorz and Jurewicz Andrzej (Univ. of Warsaw). Postepy Fiz., 11: No. 2, 191-205(1960).

A classification of elementary particles is tabularly presented. This scheme of classification includes tables made for pions, K-mesons, hyperons, nucleons, baryons, and mesons. (N.W.R.)

16355 THE RANGE-ENERGY RELATION FOR HIGH ENERGY μ-MESONS. F. Ashton (Univ. of Leeds, Eng.). Proc. Phys. Soc. (London), 77: 587-92(Mar. 1, 1961).

The range−energy relation for μ mesons with energies up to 1000 Bev is studied by comparing the sea-level energy spectrum of cosmic rays with the underground depth−intensity curve. No significant divergence from accepted theory is found. (auth)

16356 SPACE-TIME DESCRIPTION OF COLLISION AND DECAY PROCESSES. Masakuni Ida (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 24: 1135-48(Dec. 1960). (In English)

On the basis of Lorentz invariance and the existence of the vacuum, scattering amplitudes are expressed in terms of Wightman functions. This is done with the aid of observation functions, four-dimensional wave packets vanishing outside the space-time regions of observation of colliding particles. Restrictions must be imposed on each of these regions in order to assure the one-particle character of observed particles, which may be either stable or unstable. The expression, in a form modified under the additional assumption of microcausality, is compared with that of Lehmann, Symanzik, and Zimmermann and the physical meaning of the asymptotic condition is clarified. Extension of the method of description to processes involving composite particles is given, and some relativistic problems concerned with unstable particles are also discussed from the above space-time point of view. (auth)

16357 ON THE SEMI-CLASSICAL TREATMENTS OF THE MESON-NUCLEON SCATTERING. Shin Ishida (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 24: 1166-78(Dec. 1960). (In English)

The quantum mechanical treatment of static meson-nucleon scattering which has a close connection with the semi-classical one is presented. On this basis the semi-classical treatments of p-wave pion-nucleon scattering, recently developed independently by Jackson and by Weisskopf, are examined. As a result it is shown that their treatments are not complete and that, if treated correctly, their effective range formula should be modified largely. This would result in a deviation from the experimental behavior. The applications to the charged and neutral scalar theories are also given and compared with the Castillejo-Dalitz-Dyson theory. (auth)

16358 CLUSTER EXPANSION TECHNIQUE IN THE MANY FERMION SYSTEMS. [PART] I. Ki-ichi Nakamura (Nippon Electric Co., Ltd., Kawasaki, Japan). Progr. Theoret. Phys. (Kyoto), 24: 1195-1214(Dec. 1960). (In English)

A new cluster expansion technique is developed for calculating the energy expectation value of a many-fermion systems with singular potentials. The wave function is of the form $\Psi = \prod_{(i,j)} f(r_{ij}) \sum_P (-1)^P P\{\chi(1,2)\chi(3,4) \cdots \chi(2N-1,2N)\}$, which, in a special case, coincides with Jastrow wave function. The formula for the energy expectation value is written in terms of the complex cluster integrals. The method introduced in the derivation of this formula has an analogy to the classical cluster expansion method in the theory of an imperfect classical gas of multicomponents. (auth)

16359 ON THE POSSIBILITY OF THE EXISTENCE OF A NEW MESON. Chikashi Iso and Tetsuro Kobayashi (Tokyo Univ. of Education and Waseda Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 24, 1215-23(Dec. 1960). (In English)

A new meson, λ^0, which interacts only with the Λ particle is introduced to explain the mass difference between the Λ and the nucleon. The requirement that the self-energy of Λ be positive restricts the type of λ^0 to three possibilities, V(v), V(t), or PS(ps). Some properties of the λ^0 as well as ideas for possible experimental verification of its existence are discussed. (auth)

16360 ON HUGENHOLTZ-PINES' THEORY ABOUT GROUND STATE ENERGY OF INTERACTING BOSONS. Setsuo Misawa (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 24: 1224-30(Dec. 1960). (In English)

Hugenholtz and Pines have developed a new method to evaluate the ground state energy of a system of interacting bosons, the merit of which consists in the elimination of the zero-momentum state and accordingly the applicability of the linked cluster expansion. Their theory, however, does not give correct results because of the undue treatment of the zero-momentum state; this is proved in a simple example. Up to the third order coupling parameter of the ground state energy, the result of the usual Rayleigh-Schrödinger perturbation method are compared with that obtained according to Hugenholtz-Pines' theory. The latter does not agree with the former. (auth)

16361 PION-NUCLEON SCATTERING AND PION-PION INTERACTION. Shin Ishida (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 24: 1262-74(Dec. 1960). (In English)

S-wave π-N scattering is investigated from the viewpoint that π-π interaction is important. Starting from the interaction Lagrangian L_I: $-L_I = (G^2/2M) \int \rho_c(r)\phi^2(r)d^3r +$

$G/2M)^2\tau \cdot \int \rho_c(r)\phi(r) \times \dot{\phi}(r)d^3r + V(0) \int \rho_\pi(r)\phi^2(r)d^3r$, (where he third term corresponds to the effective potential obained from the original π-π interaction $H_I{}^{\pi-\pi} = \lambda(\phi \cdot \phi)^2$), he Klein-Gordon equation on the matrix-elements of the meson field operator between the nucleon state and the nucleon plus one-meson state is solved directly. Choosing Yukawa type form factors $\rho_i(r) = (4\pi r)^{-1}\Lambda_i^2 \exp[-\Lambda_i r]$, the best fit to the experimental behavior of the S-wave phase shifts is obtained for the following value of the parameters: $\Lambda_C \approx 5\mu$, $\Lambda_\pi \approx 3.5\mu$, $(2/4\pi)(G^2/2M + V(0)) = (2/4\pi)(G^2/2M)$ $2/10) \sim 0 = (0.4 \text{ to } 0)\mu^{-1}$. This choice of V(0) corresponds o the original π-π coupling constant $\lambda/4\pi = 0.3$ to 0.5 and s consistent with the value $|\lambda|/4\pi \approx 1$ determined from the π-2π) process at 1.4 Bev. On the above basis, the qualitative nature of the small P-wave phase shifts is discussed, and results which coincide with those of Lomon and Chiu are obtained. (auth)

16362 ON THE VALIDITY OF MULTIPLE DISPERSION REPRESENTATIONS. Noboru Nakanishi (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 24: 1275-95(Dec. 1960). (In English)

The validity of multiple dispersion representations is investigated in perturbation theory. The lowest-order vertex function is analyzed as functions of two and three variables. A conjecture is proposed for the possibility of double dispersion representations. As an application of the double dispersion representation, the Bethe-Salpeter equation in ladder approximation is solved in the case of total mass zero. (auth)

16363 TWO NUCLEON POTENTIAL WITH FULL RECOIL. I. GENERAL FORMALISM AND ONE-PION-EXCHANGE POTENTIAL. Norio Hoshizaki (Tokyo Univ. of Education) and Shigeru Machida. Progr. Theoret. Phys. (Kyoto), 24: 1325-48(Dec. 1960). (In English)

Nonstatic nuclear potential due to a one-pion-exchange process is derived in the momentum space without using the expansion with respect to the inverse of the mass of the nucleon. Close examinations of its properties show that it can be expressed with good accuracy by a local potential in x-space at low energies (below 300 Mev). Nonstatic parts of the potential have different signs according as whether the assumed coupling between the pion and the nucleon is pseudoscalar or pseudovector. Comparison with the experimental phase shifts is briefly discussed. It is shown in the case of the pseudoscalar coupling that the nonstatic one-pion-exchange potential derived is almost exact from the theoretical point of view when the distance between two nucleons is far enough (large compared with one third of the pion Compton wavelength). It is also argued on some physical assumptions that the potential will in fact be exact in the case of the pseudovector coupling too. (auth)

16364 ON THE SCATTERING OF K^+ BY NUCLEON AT LOW ENERGIES. Masayoshi Azuma and Takesi Ebata (Tohoku Univ., Sendai). Progr. Theoret. Phys. (Kyoto), 24: 1369-71(Dec. 1960). (In English)

The elastic K^+-N ordinary scattering cross sections are almost constant up to about 2 Bev, while the charge exchange scattering cross section rises even at low energies. Therefore the s-wave interaction predominates in K^+-N scattering. Thus the simple second-order perturbation approximation, taking recoil effect into account, was used to investigate the total cross sections. The results are plotted for three scattering amptitudes, where K^+-N elastic total cross sections versus energy are plotted in comparison with experimental data. Another figure shows the differential cross section for K^+-scattering, including the Coulomb part. (N.W.R.)

16365 ELECTROMAGNETIC VERTEX FOR $\Sigma^0 \rightarrow \Lambda^0 + \gamma$. Hiroshi Katsumori (Osaka Gakugei Univ., Osaka). Progr. Theoret. Phys. (Kyoto), 24: 1371-3(Dec. 1960). (In English)

Several relations of the vertex Γ_μ ($\Sigma^0\Lambda^0$) are examined. These relations are true to all orders in the strong interactions. A tabulation of the lowest-order perturbation results of $\mu_{\Sigma^0\Lambda^0}$ is given. The study seems to suggest that the reasonable magnitude of $|\mu_{\Sigma^0\Lambda^0}|$ is a few hyperon magetons as well as $|\mu_{\Sigma^\pm}|$, and such conjecture does not contradict the standard deviation of the recent measurement of the mass of Σ^0 ($\sim \pm 1.0$ m_e). (N.W.R.)

16366 THE ANALYTICITY PROPERTIES OF THE BETHE-SALPETER AMPLITUDE. Keiji Watanabe (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 24: 1373-6(Dec. 1960). (In English)

The Bethe-Salpeter amplitude is examined with the anticipation that the normal and abnormal solutions should have some differences in their analyticity properties. No difference was found in the case where the mass of the intermediary boson is zero. (N.W.R.)

16367 NOTE ON THE D(γ,p)n REACTION AT THE γ-RAY ENERGY OF 164 Mev. Masahiko Matsumoto (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 24: 1376-8(Dec. 1960). (In English)

The differential cross section and proton polarization were computed for a γ energy of 164 Mev. For the deuteron wave function and the interaction operator of E1, E2, and spin flip M1, two types of interaction operators for each transition are used in order to determine retardation effect. Comparing the results due to the interactions, the retardation effect gives a total cross section larger than that for the conventional interaction. The retardation effect really gives the larger cross section σ_t (E1) for the E1 transition, but larger cross sections are found in conventional interaction for E2 and spin flip M1 transitions. This is unexpected. Both angular distributions are similar but the conventional interaction shows a forward asymmetry depending on the larger E2 transition amplitudes. Total cross sections and angular distributions do not agree with experimental data, and have rather small values. (N.W.R.)

16368 APPLICATION OF ρ-MESON THEORY TO 5 Bev π^--p DATA. Hiroshi Nakamura (Tokyo Inst. of Tech.). Progr. Theoret. Phys. (Kyoto), 24: 1380-1(Dec. 1960). (In English)

The angular distribution of protons from π^--p inelastic collisions at 5 Bev suggests a sharp tendency to forward scattering, and this fact is favorable for the existence of some isobaric states. Using ρ-meson or (1,1) nucleoneum, a Feynman diagram was calculated and applied to the 5 Bev data. (N.W.R.)

16369 THE PRODUCTION AND FOCUSING OF INTENSE CHARGED PARTICLE BEAMS. V. P. Ignatenko. Uspekhi Fiz. Nauk, 73: 243-75(Feb. 1961). (In Russian)

The principles of producing and focusing intense charged particle beams are reviewed, and the types of focusing and basic laws of flux conservation are discussed. Non-relativistic beams in the absence of magnetic fields, the formation of beams by Pierce electrodes, and intense charged particle beams in magnetic fields are considered. Centripetal and periodic focusing, approximation methods for calculating intense beams, and the influence of relativistic effects and initial velocity rates are analyzed. Computer systems and methods of intense beam simulation are also discussed. 214 references. (R.V.J.)

Neutron Physics

16370 (AERE-R-3353) RESONANCE TRANSMISSION ANALYSIS FOR s-WAVE NEUTRONS. I. TABLES OF AREA FUNCTIONS FOR NATURAL RESONANCES. J. E. Lynn (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). May 1960. 6p.

Tables of area functions are given for the case of natural resonance cross sections for use in the analysis of s-wave neutron resonance transmission data. This area method makes use of the fact that the area above a resonance dip in a curve of neutron transmission as a function of energy is independent of instrumental resolution. (M.C.G.)

16371 (CEA-1679) SUR QUELQUES PROBLEMES CONCERNANT LA PULSATION RAPIDE DU FAISCEAU D'UN GENERATEUR DE NEUTRONS. (Some Problems Dealing with the Rapid Pulsing of a Neutron Generator Beam). Krsto Prelec (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléares, Saclay). 1960. 91p.

A discussion is given of the fundamental properties of some simple chopper systems. The relations for burst duration, exit angle of the beam after the slit, and maximum deflection are given; the results are presented in graphical form for convenience. Velocity modulation as a means of bunching the particles behind a slit-deflector system is investigated. Expressions for the minimum distance for bunching φ_0, bunching factor γ_0, and HF power are given for the case of single or multiple slit modulation. Beam acceleration following velocity modulation was investigated. Results are presented graphically. The space charge effects on an ion packet during bunching are given. A simple differential equation expressing particle motion in axial and radial directions was derived on the basis of certain approximations. Numerical integration of the equation was carried out for a number of values of the parameters. (auth)

16372 (CRNP-947) METHODS FOR NEUTRON SPECTROMETRY. B. N. Brockhouse (Atomic Energy of Canada Ltd., Chalk River, Ont.). Jan. 9, 1961. 91p. (AECL-1183).

Presented as Paper No. IS/18 at the Symposium on Inelastic Scattering in Solids and Liquids, Vienna, October 11-14, 1960.

The appropriate theories and the general philosophy of methods of measurement and treatment of data neutron spectrometry are discussed. Methods of analysis of results for liquids using the Van Hove formulation, and for crystals using the Born-von Kármán theory, are reviewed. The most useful of the available methods of measurement are considered to be the crystal spectrometer methods and the pulsed monoenergetic beam/time-of-flight method. Pulsed-beam spectrometers have the advantage of higher counting rates than crystal spectrometers, especially in view of the fact that simultaneous measurements in several counters at different angles of scattering are possible in pulsed-beam spectrometers. The crystal spectrometer permits several valuable new types of specialized experiments to be performed, especially energy distribution measurements at constant momentum transfer. The Chalk River triple-axis crystal-spectrometer is discussed, with reference to its use in making the specialized experiments. The Chalk River rotating crystal (pulsed-beam) spectrometer is described, and a comparison of this type instrument with other pulsed-beam spectrometers is made. A partial outline of the theory of operation of rotating-crystal spectrometers is presented. The use of quartz-crystal filters for fast neutron elimination and for order elimination is discussed. (auth)

16373 (GA-1838) A MARKOV-CHAIN TREATMENT OF NEUTRON THERMALIZATION. D. H. Perkel (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Dec. 9, 1960. 28p. Contract AT(04-3)-167. Project Agreement No. 2. Project 48.01.

The thermalization of neutrons in a moderating material is viewed as a Markov process in which there is one absorbing state and the energies are the transient states. The state populations are the neutron densities. By replacing the continuum of thermal energies with a set of energy intervals, the process is reduced to a finite Markov chain. (auth)

16374 (GAMD-920) LEAST SQUARE DETERMINATION OF NEUTRON STRENGTH FUNCTION FROM LOW ENERGY RESONANCE DATA—650 WOLONTIS. C. Bell (General Atomic Div., General Dynamics Corp., San Diego, Calif.). July 23, 1959. Contract AT(04-3)-187. 4p. (MGCR-R.P.-77).

The computer program is designed to determine the neutron strength function, $\overline{\Gamma_n^0}/D$, of isotopes from low-energy neutron resonance measurements. It determines the least square straight-line fit to a plot of the sum of reduced neutron widths, Γ_n^0, for resonances below the neutron energy as a function of the neutron energy. The slope of the straight line is $K(\overline{\Gamma_n^0}/D)$, where K is one for even Z, even N nuclei and K is two for other nuclei. The average reduced neutron width, $\overline{\Gamma_n^0}$, the intercept on the $\Sigma\Gamma_n^0$ axis, C, and the standard deviation of the least square fit are obtained. (auth)

16375 (KAPL-M-PAO-1) EFFECTIVE FAST GROUP CROSS SECTIONS IN FEW GROUP DIFFUSION THEORY. P. A. Ombrellaro (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 7, 1961. Contract W-31-109-Eng-52. 41p.

In burnup calculations, the few-group space-dependent flux is calculated by solving the few-group diffusion equations using few-group infinite medium diffusion theory parameters as coefficients. During the lifetime, it is necessary to account for changes in the diffusion theory parameters due to the changes in the energy flux spectrum which is directly correlated with the change in the concentrations of the elements composing the medium. In order to compute infinite medium diffusion theory parameters quickly in burnup codes, it is necessary to rely on simple models which calculate diffusion theory parameters with the same accuracy as the MUFT and KATE codes. Two schemes for calculating diffusion theory parameters quickly were developed and incorporated in the FICS code, which is the automatic diffusion theory parameter preparation component of the KARE code. The first scheme is called the fitted cross section scheme and calculates three, two, and one lethargy group diffusion theory parameters for the energy range 0.625 ev to 10 Mev. The fitted cross section scheme employs a model whereby the diffusion theory parameters are expressed in terms of three and two group average microscopic cross sections obtained by fitting to the MUFT results for binary mixtures of one metal and water over a range of metal-to-water volume ratios. The formulation of the fitted cross section scheme and the procedure for obtaining the fitted microscopic cross sections are described. Comparisons of fitted and MUFT diffusion theory parameters calculated for some clean stable cores are presented. The second scheme will be described in a later report. (D.L.C.)

16376 (TID-12108) NEUTRON CROSS SECTION AND SPECTRA STUDIES. Technical Progress Report. P. F. Zweifel (Michigan. Univ., Ann Arbor. Coll. of Engineering). Mar. 1961. Contract AT(11-1)-917. 13p. (ORA-03712-1-P)

The merits of different systems of a mechanical neutron monochromator were investigated and the design of P. A. Egelstaff et al., adopted. The design and progress in the assembly of the neutron monochromator are described. Theoretical and experimental studies of the Ford Nuclear Reactor were undertaken in hopes of increasing the available neutron intensity. Theoretical studies of liquid structure were begun for simple cases. (M.C.G.)

16377 (WAPD-TM-221) NUCLEAR REACTOR DEPLETION PROGRAMS FOR THE PHILCO-2000 COMPUTER. O. J. Marlowe (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Jan. 1961). Contract AT(11-1)-Gen-14. 118p.

The CANDLE, TURBO, and DRACO depletion programs for the IBM-704 computer were extended to the Philco-2000 computer as a set of consistent programs. The calculations are based on few-group neutron-diffusion theory in which the group-averaged macroscopic cross sections are computed from fitted few-group microscopic cross sections. The build-up or depletion of isotopic number densities describing the materials present is calculated from the fitted cross sections and the neutron flux. The flux is assumed to be constant over the time interval of each step and is recomputed for each succeeding step. Mesh point limitations are 500 points, 20,000 points, and 100,000 points for the one-, two-, and three-dimensional versions, respectively. (auth)

16378 (WAPD-TM-268) RANCH—AN IBM-704 PROGRAM USED TO SOLVE THE ONE-DIMENSIONAL, SINGLE ENERGY NEUTRON TRANSPORT EQUATION WITH ANISOTROPIC SCATTERING. L. A. Hageman and J. T. Mandel (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Feb. 1961. Contract AT(11-1)-GEN-14. 25p.

The RANCH program furnishes a numerical approximation to the one-dimensional, one-velocity neutron transport equation in slab geometry. The method of discrete ordinates with the iteration process accelerated by overrelaxation is used to obtain the solution. The restrictions imposed by the program are given and the preparation of input described. (auth)

16379 SCATTERING OF SLOW NEUTRONS BY MOLECULES. A. Rahman (Tata Inst. of Fundamental Research, Bombay). J. Nuclear Energy, Pt. A. Reactor Sci., 13: 128-32(Jan. 1961). (In English)

The scattering of neutrons by a rotating rigid molecule is analyzed for incident neutron energy of the same order of magnitude as the rotational level separations. When the energy of the incident neutron is large, the method of using the rotator as a model for a spherical top molecule is justified. The inclusion of zero-point vibrations is considered. (auth)

16380 DIFFERENTIAL EQUATIONS FOR STOCHASTIC MODEL OF NEUTRON DENSITY EVOLUTION IN MULTIPLYING MEDIUM. J. Larisse and P. Braffort (Europeenne de l'Energie Atomique, Brussels). J. Nuclear Energy, Pt. A. Reactor Sci., 13: 133-40(Jan. 1961). (In French)

A stochastic model is described which expresses the density of individuals walking in multiplicating media such as nuclear reactors. By means of this model, probability laws were obtained for a number of random variables connected to the stochastic process, principally the stochastic differential equation for population density evolution and the associated diffusion equation of probability. It is then possible from the stationary case to determine the fluctuation power spectrum. (auth)

16381 THE APPLICATION OF THE VARIATIONAL METHOD TO NEUTRON TRANSPORT THEORY. G. Rowlands (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Energy, Pt. A Reactor Sci., 13: 176-82(Jan. 1961). (In English)

Two distinct ways in which the variational method may be used to obtain approximate solutions of the equations which are involved in neutron transport theory are discussed. In the first, a method is given whereby an estimate of an eigenvalue or some weighted average of the solution of the equation is obtained. The second way is a method by which a relatively complicated equation involving multi-dimensional variables is reduced to a number of simpler equations, each in a fewer number of independent variables. (auth)

16382 THE CALCULATION OF THE FERMI AGE IN A HETEROGENEOUS ARRANGEMENT OF MODERATORS BY THE AGE THEORY. K. Meyer (Wissenschaftlich-Technisches Büro für Reaktorbau, Berlin-Pankow, Ger.). Kernenergie, 3: 1135-43(Dec. 1960). (In German)

The Fermi age of neutrons from a monoenergetic neutron source moderated to a low energy with respect to the source energy is calculated for a simple arrangement. This arrangement consists of a plate lattice of two non-absorbing, only elastically scattering, moderator materials with sufficient high nuclear mass numbers. The assumption was made that the scattering cross sections in the partial regions are energy independent. (J.S.R.)

16383 MEASUREMENT OF THE SPECTRUM OF THERMAL NEUTRONS RELEASED FROM GRAPHITE UNDER VARIOUS GEOMETIC CONDITIONS. K. F. Alexander, A. Andreeff, and T. Kampf (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 3: 1144-7(Dec. 1960). (In German)

By means of a simple time-of-flight spectrometer the neutron spectrum from the thermal column of the RFR was measured under two distinct geometric conditions. It was shown that the spectrum has only approximately the form of a Maxwell distribution. The position of the maximum depends on the geometry of the total surface. This dependence was explained with the diffusion theory. (tr-auth)

Nuclear Properties and Reactions

16384 (AERE-R-3347) A CALCULATION OF THE ASYMMETRY DUE TO AN EXTENDED SECOND TARGET IN EXPERIMENTS TO DETERMINE NUCLEAR SPIN POLARIZATION. J. E. Evans (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). May 1960. 8p.

The equation, $\frac{R}{L} = \frac{1 + P_1P_2}{1 - P_1P_2}$, which is used to determine the spin polarization produced in nuclear reactions, was solved for the case of the extended target, where R/L is the ratio of the intensities of the final reaction product measured to right and left of the second target, and P_1 and P_2 are defined as the polarizations at the mean angles set by the apparatus. An illustration is given for results obtained for an experiment of double-scattering of protons on carbon-12. (B.O.G.)

16385 (ANL-6288(p.13-19)) DISPERSION OF GYROMAGNETIC RATIOS IN COMPLEX SPECTRA. Norbert Rosenzweig (Argonne National Lab., Ill.).

Some consequences of a statistical hypothesis of the Hamiltonian for highly excited nuclear states, by which

a varying degree of repulsion of atomic energy levels was explained in terms of a suitable random matrix hypothesis, are applied in development of statistical properties for the gyromagnetic ratios of complex quantum systems. Hypothetical cases of complex atoms are considered. Study of the empirical distribution of the gyromagnetic ratio for many elements reveals that it is fairly close to gaussian. (J.R.D.)

16386 (ARF-1166-9) STUDIES OF NUCLEAR RESONANT ABSORPTION OF GAMMA RAYS. Quarterly Report No. 3, December 1, 1960 to March 1, 1961. L. Reiffel (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Mar. 18, 1961. Contract AT(11-1)-578. 33p.

Experimental apparatus was fabricated, tested, and perfected for use in experiments designed to test the feasibility of using nuclear resonance absorption for various purposes. Preliminary work was carried out with Fe^{57} resonant absorption. The low-lying excited state of Fe^{57} at 14.4 kv was excited by β decay of Co^{57}. It was found that Co^{57} embedded in a pure iron host lattice makes an excellent source. Three types of natural iron absorbers were investigated. For the work, the most promising radiation detector appeared to be thin scintillation crystals or high resolution proportional counters. Special apparatus was assembled to study the effect of both uni-axial strain and hydrostatic pressure on the resonant absorption. (M.C.G.)

16387 (ARL-TN-60-134) RANGE STRAGGLING OF PROTONS, ALPHA PARTICLES, CARBON^{12} AND OXYGEN^{16} IONS. D. R. Locker (Wright Air Development Center. Aeronautical Research Lab., Wright-Patterson AFB, Ohio). Dec. 1960. 46p.

An analysis was made of the range distribution of protons, alpha particles, C^{12}, and O^{16} ions accelerated to about 10.4 Mev per nucleon in a 60-inch cyclotron. The proton measurements are unique in that ionized molecular hydrogen was accelerated, resulting in proton pairs of equal energies, which enhances the straggling study. The alpha particles and C^{12} ions were accelerated simultaneously, providing a point of range-energy comparison for a light and a medium mass nucleus. An approximate calculation was made of the coulomb nuclear straggling in the C^{12} and O^{16} ranges. (auth)

16388 (GACD-1750) RANGE OF RECOIL ATOMS. Fourth Quarterly Report, July 1, 1960 through September 30, 1960. V. A. J. van Lint (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Oct. 12, 1960. Contract AF33(616)-6795. 9p.

Studies were performed to verify the theoretical prediction that the recoil fraction produced by (e,e'n) reactions is the same as that produced by (γ,n) reactions as long as the bremsstralung energy equals the electron energy. Cu, Au, and Ag foil sandwich agreements were irradiated at 14, 18, and 26 Mev. With the single exception of the 18-Mev irradiation on gold, the recoil ratios induced by (e,e'n) reactions appeared to be about 5 to 10% higher than for corresponding bremsstralung energies. However, in all cases these results agreed within experimental errors with the theoretical prediction. Thin films of copper evaporated onto aluminum were irradiated and the recoil fractions in the forward and backward direction were measured. The forward and backward recoil fractions for the products of the following reactions were also determined: $Ti^{48}(\gamma,p)Sc^{47}$ and $Zn^{68}(\gamma,p)Cu^{67}$. The amount of impurity Cu, Ag, and Au in aluminum foils was determined by activation analysis. (M.C.G.)

16389 (GAMD-276) THE TOTAL NEUTRON CROSS SECTION AS A FUNCTION OF ENERGY FOR ZIRCONIUM HYDRIDE, WATER AND MAGNESIUM HYDRIDE. William L. Whittemore (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Jan. 20, 1958. Contract AT(04-3)-167. Project Agreement No. 1. 15p.

Results of an investigation of neutron interaction with hydrogenous materials are presented. Included in the study are total neutron cross sections as a function of the energy of the incident neutron for zirconium hydride, water, and magnesium hydride. In zirconium hydride, the predicted structure with discrete energy levels is observed, while in magnesium hydride the energy levels are not clearly resolved. The variation in water cross sections is smooth, with no evidence of energy levels. (J.R.D.)

16390 (JAERI-4016) TEI ENERUGI GENSHIKAKU KENKYUKAI HOKOKU. (Proceedings of the Conference on Low Energy Nuclear Physics, JAERI, July 6-8, 1960). (Japan Atomic Energy Research Inst., Tokyo). Dec. 1960. 106p.

Fifteen papers are included; separate abstracts have been prepared for each. (D.E.B.)

16391 (JAERI-4016(p.2-6)) SHINDO RYOIKI-NO GUGUKAKU-NI TSUITE. (Vibrational States in Even-Even Nuclei). Hisashi Horie (Tokyo Inst. of Tech.).

For the even-even nuclei with neutron numbers approximately given by $24 \leq N \leq 88$ or $114 \leq N \leq 132$, the simple perturbational calculation of the levels on the basis of collective oscillation induced in a spherical liquid drop nucleus can successfully explain the following observed phenomena. The second excited states usually have the spin and parity assignment of 0+, 2+, or 4+. The ratio of the second excited level to the first excited level, E_2/E_1 is approximately 2.2. In a gamma-cascade involving the initial nucleus 2+, intermediate nucleus 2+, and the ground level of 0+, the first gamma ray is almost purely electric quadrupole transition, and the crossover radiation is absent. The electric quadrupole transition probability between two adjacent levels is much greater than the values predicted on the basis of the single particle model. Refinement of the calculation is achieved by assuming an even number of nucleons outside the spherical core, or by assuming an ellipsoidal core. The asymmetric rotator model was also useful in various regions. Future improvement in the theory will depend largely on the clarification of the relationship between the shell structure and the collective motion, and detailed observation of the region of transition from magic nuclei to vibrational nuclei. (JPRS)

16392 (JAERI-4016(p.7-13)) GENSHI KAKU NO ASYMMETRIC ROTATOR MODEL TO SONO KAKUCHO. (Asymmetric Rotator Model of the Nucleus and Its Extension). Schota Suekane (Osaka City Univ.).

The scheme of the Davydov-Filipov asymmetric rotator model was extended to include the possibility of the beta and gamma oscillations, and then used to obtain a unified description of the even-even nuclei in both rotational region and vibrational region. Beta and gamma were defined as the surface coordinates to describe the 2nd order deformation of nuclei in the body-fixed frame. The rotational region was characterized by gamma $\sim 10°$ and the vibrational region by gamma $\sim 26°$. There was an extremely rapid change in gamma in the transitional region. The internal motion was treated adiabatically with respect to the collective motion. The energy of the internal motion was taken as the potential energy of the collective motion. The average oscillation potential could be calculated under the assumption that the equipotential surface is similar to the nuclear shape. The approximate eigenvalues and eigenfunctions of both beta oscillations and gamma oscillations were obtained by expanding the above potential in the neigh-

rhood of certain equilibrium deformations, which were tained by Gursky by finding the minimum energy points the anisotropic oscillator potential. Spin-orbit coupling s not taken into account. The change in the rotational ergy caused by deviating from these equilibrium defor- ation points was taken as the rotation-vibration interac- n. The value calculated for this interaction could be trapolated to the case of the axially symmetric deforma- n, in which case the value was in exact agreement with ohr-Mottelson calculation. (JPRS)

16393 (JAERI-4016(p.14-20)) ROTATIONAL REGION-O GUGUKAKU-NI TSUITE. (Even-even Nuclei in the otational Region). Takeshi Udagawa (Tokyo Univ. of ducation).

The asymmetric rotator model of Davydov-Filipov gives correct description of the properties of low-excited states vibrational and rotational nuclei from a unified point of ew. The model faces a serious difficulty in being unable account for certain types of excited levels, notably the otational band with 0+ intrinsic excited state. The conven- onal Bohr-Mottelson treatment of collective motion on the asis of rotation of stably deformed ellipsoidal nuclei and urface oscillation of such nuclei can be successfully used o reproduce the result of the asymmetric rotator model. he ratio of reduced transition probability of certain typi- al gamma rays was computed for a few nuclei on the basis f Davydov-Filipov model and Bohr-Mottelson model re- pectively, and the results are compared with the experi- ental data. The conventional model was further applied to alculate the mass parameter and the rigidity of the gamma- ibration for twelve nuclei in the rotational region, taking nto account the effect of pairing interaction by the method f Belyaev. The energy of gamma quanta was subsequently alculated and compared with the experimental values of he gamma-vibrational levels with spin and parity 2+. The onventional collective model with rotational and vibra- ional modes of motion seemed to be more effective and ealistic than the Davydov-Filipov model in explaining the ow-excited states in even-even nuclei in the rotational re- ion. A few of the difficulties facing the conventional model re mentioned. (JPRS)

16394 (JAERI-4016(p.21)) V^{51} NO M1 TENI-NI TSUITE. (M1 Transition in V^{51}). Hisashi Horie (Tokyo Inst. of Tech.).

The measured lifetime of the transition from the first excited level to the ground state of V^{51} is significantly longer than the value predicted by the single particle model with configuration mixing. In the calculation the nuclear in- teraction was obtained by use of the δ-function. A more detailed calculation of the transition probability on the basis of finite range of nuclear interaction was carried out by solving the secular equation. When the finite range was ad- justed to fit the pairing energy of Ca^{42}, the calculated M1 transition probability and the magnetic moment were in satisfactory agreement with the experimental result. (JPRS)

16395 (JAERI-4016(p.22-7)) DOKURITSU RYUSHI MOKEI-NI OKERU ENERUGI GYORETSU-NI TSUITE. (Interaction Matrix Elements in Independent Particle Model). Hisashi Horie (Tokyo Inst. of Tech.).

When the two-body interaction including non-central force is Fourier-analyzed, each component can be expanded in terms of products of spherical harmonics. The calculation of the interaction matrix elements from such expansion is shown to be far more straightforward than the conventional method which employs the expansion of the interaction in Legendre polynomials. The Fourier transformation makes it possible to separate the two radial coordinates r_1 and r_2 in the subsequent integral. Each Fourier component was expressed in the three-dimensional isotropic harmonic oscillator wave function, and the basic radial integrations were obtained. Then the radial integration for an arbitrary potential could be obtained as a linear combination of such basic integrals. Then the radial integration involved only the expansion coefficients of the associated Laguerre poly- nomials in power series. Useful recursion formulas were obtained. The result of the calculation could be simply re- lated to Talmi's calculation which separates the center of mass motion and the relative motion. The Gaussian well and the Yukawa well for the short-range limit and the long- range limit were studied in some detail. (JPRS)

16396 (JAERI-4016(p.28-34)) NUCLEAR SHELL MODEL-NI OKERU RESIDUAL INTERACTION-TO PAIR- ING ENERGY. (Pairing Energy and Residual Interaction in the Nuclear Shell Model). Kiyoshi Sasaki (Tokyo Met- ropolitan Univ.) and Hisashi Horie (Tokyo Inst. of Tech.).

The pairing energy for nucleons in various configurations was deduced from experimental data on nuclear binding en- ergy. The average potential operating on a single nucleon outside a closed shell was assumed to be independent of the number of the nucleons outside the closed shell. The effect of configuration mixing on the binding energy was neglected. Assuming the interaction of the paired nucleons to be a two- body force, the interaction was expressed as a sum of a spin-independent and a spin-dependent central force with a common factor for the radial dependence. The pairing en- ergy of the nucleons with the configurations $1d_{\frac{5}{2}}$, $1d_{\frac{3}{2}}$, $1f_{\frac{7}{2}}$, and $1g_{\frac{9}{2}}$ were mainly considered. The common radial de- pendence was assumed to be either Gaussian or Yukawa- type. In deducing the pairing energy from the experimental data, it was found to be useful to define a parameter π with the dimension of energy which becomes equivalent to the pairing energy P for the short range limit. The matrix elements of P and π for the different configurations were computed and tabulated as a function of the range parame- ter of the interaction. Comparison of the theoretical values and the experimental results determined the strengths of the spin-independent and the spin-dependent interaction, V_0 and V_1, respectively. V_1/V_0 was 1/11 for δ-force, -1 for Serber force, and 2.3 for Rosenfeld force. Under a reason- able assumption for the range, the interaction of the paired nucleons in the average potential of the core seemed to be close to Rosenfeld-type. The investigation was not in agree- ment with Talmi's investigation of the binding energy for $1f_{\frac{7}{2}}$ nor with Thieberger's results in which the exchange forces were also considered. (JPRS)

16397 (JAERI-4016(p.35-6)) ELECTRIC MONOPOLE TRANSITION-NI TSUITE. (Electric Monopole Transition). Hidetsugu Ikegami (Tokyo Univ. Inst. for Nuclear Study).

The E0 transition between two nuclear levels with the same spin and parity is possible by an internal pair pro- duction or by an internal conversion. For the $2+ \rightarrow 2+$ transition in Pt^{196} the angular correlation involving the in- ternally converted electrons was carried out with a preci- sion exceeding the previous experiments by other workers. The presence of E0 transition was confirmed by observing the interference between E0 transition and the other com- peting E2 and M1 transitions. The transition probability of E0 transition by internal conversion is a product of an elec- tronic factor and a nuclear strength parameter. The latter is nearly 1 for a transition with no change in orbital and total spins when the shell model is applicable. It is very small for all other cases. (JPRS)

16398 (JAERI-4016(p.37-43)) GUGUKAKU-NO REBERU YOSHIKI. (Level Schemes of Even-even Nuclei). Eiko Takekoshi (Japan Atomic Energy Research Inst., Tokyo).

Data about the level schemes of nuclei with $72 \leq A \leq 144$ were tabulated in a form which made it easier to identify the features of the vibrational motion belonging to the low-lying levels. Most of the data were collected from the Nuclear Data Sheet and Seaborg's tables with only a few revisions. The ratio of the energy of the second excited level with 2+ to the energy of the first excited level with 2+ is also included. The ratio of the reduced transition probability of the transition from the second 2+ level to the first 2+ level to that of the cross-over radiation is also included wherever possible. The Davydov-Filipov asymmetric rotator model was used to calculate this ratio with good agreement with the experimental results. Some other areas in which the Davydov-Filipov model is in good agreement with the experimental data are briefly discussed. The reliability of the parity and spin assignment is discussed by taking a few explicit examples including the 0+ level in Ge^{72}, 0+ and 4+ levels in Se^{78}, and others. (JPRS)

16399 (JAERI-4016(p.44-56)) GUGUKAKU-NO BOKKI JOTAI-NI TSUITE. (Excited States in Even-Even Nuclei). Masao Nozawa (Japan Atomic Energy Research Inst., Tokyo) and Takeshi Yamazaki (Osaka Univ.).

The systematics of the nuclei in the vibrational region were studied on the basis of the data about the low-lying excited states in these nuclei which are given in the Nuclear Data Sheet. For a fixed proton number the number of neutrons was plotted as abscissa and the first excited level as ordinate in a semi-log plot. When the study was extended to include forty different proton numbers, it was noticed that for a fixed proton number the curves are approximately straight lines indicating that the energy of the first excited state changes exponentially with the increase in neutrons. It was also found that the slope of the straight line changes smoothly as the proton number is increased. A similar study was partly carried out with protons and neutrons interchanged. The plots were used to predict the position of the first 2+ levels in six nuclides in which they have not yet been found. (JPRS)

16400 (JAERI-4016(p.57-61)) $Al^{27}(p,\gamma_0 + \gamma_1)Si^{28}$. Kazuta Okamoto (Tohoku Univ., Sendai, Japan).

A variable energy cyclotron was used to study the giant resonance of the reaction $Al^{27}(p,\gamma)Si^{28}$. The two gamma rays due to transitions leading to the first excited state and the ground state of the daughter nuclei, respectively, were not resolved. The giant resonance of this reaction was split into two peaks at 20 and 21 Mev of the incident proton energy. Under the assumption that the splitting is due to the nuclear deformation, the nuclear eccentricity was calculated to be 0.05 for Si^{28}. This value was intermediate between the eccentricities calculated for Al^{27} and Si^{29} by the Chalk River group. As a qualitative test of the Sawicki model, the angular correlation of the (γ,p) reaction was studied with the target nuclei Li, S, Ni, and Cu. Protons with energy between 5 and 10 Mev were counted by a ZnS detector. The backward rise which was predicted by the Sawicki model was actually observed in the case of copper at the photon energy of 22 Mev, but was absent or ambiguous in other cases. The angular correlation of the $Cu(\gamma,p)$ reaction was studied further by using photographic emulsions in which the backward rise was clearly observed for proton energy lower than 4 Mev. The Sawicki model describes the absorption of photons by the resonance between the photon and the surface vibration of the nuclei, and expects the asymmetry to be pronounced for the low energy spectrum of protons. (JPRS)

16401 (JAERI-4016(p.64-73)) FLUCTUATION-NI TSUITE. (Fluctuation in Nuclear Reaction). Mitsuji Kawai (Tokyo Inst. of Tech.).

The elastic and inelastic scattering of protons in the vicinity of 10 Mev by light and intermediate nuclei exhi relatively rapid change in total cross section as a funct of energy. These rapid changes indicated resonances w are spaced at more than 100 kev. Such spacing was too large to be accounted for by the levels in the compound clei. On the other hand the change was too rapid to be e plained by the optical model. This type of change in cro section was tentatively called fluctuation. The experime tal values for the differential cross section for a few lig and intermediate nuclei are schematically shown. Then fluctuation is shown to be greater for the elastic scatter than the inelastic scattering. It was greater in the light nuclei than in the intermediate nuclei. The fluctuation w more regular toward the high energy. The fluctuation ca be interpreted by a channel coupling formalism taking in account the distortion of the collective core potential by proton and the effect of the virtual excitation and de-exci tion. From the compound nucleus point of view, the fluct tion may be ascribed to the statistical fluctuation of the compound nucleus levels within the energy spread of the proton beam. Blatt-Weisskoph analysis of the level separation was employed to support the latter view. Related fluctuation phenomena were also seen in the energy spectrum of the inelastically scattered alpha particles from Al^{27}. (JPRS)

16402 (JAERI-4016(p.74-83)) CHUKAN ENERUGI KAKU HANNO-NI TAISURU RESONATING GROUP MODE (Resonating Group Model for the Nuclear Reactions with Intermediate Energy). Ko Izumo (Tokyo Univ. Inst. for Nuclear Study).

A recent precise determination of the excitation curve for the intermediate energy (p,p'), (p,γ), (p,α), (p,α'), and (γ,p) reactions showed the presence of anomalous resonances whenever the target nuclei mass number exceeded 25 and the excitation energy was between 10 and 30 Mev. The separation of the resonances was approximately 200 kev or 100 times the expected values from the compound nucleus. The width of the resonance was approximately 50 kev which was $1/20$ of the expected value for the giant resonance. The experimental data of angular correlation and excitation functions involving a few interesting nuclei, notably Al^{27}, were obtained by a variable energy cyclotron and are schematically presented. When the anomalous resonance was considered to be a giant resonance level, a calculation of its life-time characterized the anomalous resonance as intermediate between a compound nucleus level and an optical nucleus level. The life-time was short enough to make plausible the assumption that the average potential of the whole target nucleus does not participate in the reaction but a part of it contributes to the reaction. Under these circumstances the hamiltonian separated into a part involving the core alone and the other part involving the outer-nucleon and the incident particle. Qualitative agreement was obtained between the gross features of the anomalous resonance and the theoretical prediction on the basis of the resonating group involving the inert core and the outer nucleons. (JPRS)

16403 (JAERI-4016(p.84-5)) KAKU HANNO-NO DIRECT INTERACTION-TO KAKU KOZO. (Nuclear Structure and Direct Interaction in Nuclear Reactions). Haruo Ui (Tokyo Univ.).

The differential cross section for the inelastic scattering of nucleons was obtained by the asymmetric rotator model of Davydov-Filipov for various values of the deformation parameter. Two cases were considered in which the reaction led to the first 2+ excited state or the second 2+ excited states. If the asymmetric rotator model is valid, the

gular correlation of the inelastically scattered nucleons ll be similar for the two cases. The vibrational model edicts distinct angular correlations for the two cases. e predictions by the two models about the reactions lead- g to higher excited levels are also briefly discussed. PRS)

404 (JAERI-4016(p.86-93)) KOSOKU CHUSEISHI- O HIDANSEI SANRAN-NO KAKU BUMPO. (Angular Dis- ibution of Inelastic Scattering of Fast Neutrons). Shigeya anaka (Japan Atomic Energy Research Inst., Tokyo).

The angular distribution of the neutrons scattered by sul- r was measured by time-of-flight analysis. The neutrons ere obtained by bombarding the heavy water target with a ulsed deuteron beam from a 2-Mev Van de Graaff accel- rator. The target to scatterer distance was 10 cm and the catterer to the detector distance was 2 m. The time-of- ight spectrum showed an elastic scattering at 3.60 Mev, nd an inelastic scattering leading to 2+ excited state at .36 Mev. Angular distribution of the elastically scattered eutrons was measured at incident energies of 3.525, 3.86, .20, 4.52, and 4.80 Mev. The agreement of the new re- ults with previously published data is discussed. At 4.52 lev the spectrum was slightly forward peaked. This fea- ure is interpreted as an indication of the violation of the tatistical assumption in the compound nucleus analysis. he previously published results of the angular correlation f inelastically scattered fast neutrons are reviewed for leven nuclei and the possible violation of the statistical ssumption in the compound nuclei analysis is discussed or these results. (JPRS)

6405 (JAERI-4016(p.94-100)) CHUSEISHI-NO HIDAN- SEI SANRAN. (Inelastic Neutron Scattering). Kazuaki Nishimura and Shiro Kikuchi (Japan Atomic Energy Re- search Inst., Tokyo).

Recent data on the inelastic scattering of neutrons with subsequently observed photons are reviewed and tabulated. The excitation curves of $(n,n'\gamma)$ reactions for various nu- clei are also collected. The nuclei was classified according to whether the reaction was in poor, good, or excellent agreement with the theoretical curves proposed by Hauser and Feshbach. Only two nuclei, Bi^{209} and Mn^{55}, were in ex- cellent agreement with the theory. An attempt was made to apply the complex potential model to inelastic scattering. The parameters defined by Beyster for the optical model were chosen to obtain the best fit of the observed elastic and total cross section. When the parameters were so chosen for Ag^{107}, Ag^{109}, and Cd, the experimentally deter- mined excitation function was considerably lower than the theoretical values. Better agreement may be obtained if the surface absorption model is employed. The use of a smaller imaginary potential for the even-parity waves than for the odd-parity waves in the vicinity of the mass num- ber 100 is proposed. (JPRS)

16406 (JINR-D-633) ON RESONANCES IN INELASTIC K-MESON-NUCLEON SCATTERING. Yung Wang and Shih-ko Hu (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1960. 5p.

A method similar to that of Carruthers and Bethe, and Peierls is used to investigate K-N scattering, and a number of resonances is found. Relations are derived between the resonance energy and the isobaric mass for a number of K-p reactions. The ratios of cross sections for a number of K-p reactions are also discussed. (D.L.C.)

16407 (LAMS-2489) CRITICAL MASSES OF COM- POSITES OF Oy AND Pu-239-240 IN FLATTOP GEOME- TRY. D. M. Barton, William Bernard, and G. E. Hansen (Los Alamos Scientific Lab., N. Mex.). Dec. 1960. Con- tract W-7405-ENG-36. 18p.

Three critical plutonium-enriched uranium composites with plutonium of different Pu^{240} content are described. In these systems one gram of Pu^{240} is equivalent to ~0.63 grams of Pu^{239} and an analysis is presented which trans- lates this datum to $\bar{\nu}(Pu^{240}, 2\ Mev) = 3.32 \pm 0.14$ neutrons emitted per Pu^{240} fission induced by a 2 Mev neutron. (auth)

16408 (NYO-9682) CONTRIBUTION OF NEUTRAL PIONS TO PHOTON-PHOTON SCATTERING. M. Y. Han and S. Hatsukade (Rochester, N. Y. Univ.). Mar. 16, 1961. Contract AT(30-1)-875. 11p.

The correction to photon-photon scattering processes due to the existence of the particles other than electrons is reported. The correction is of the same order in the electric charge as the lowest order term in the perturba- tion expansion in quantum electrodynamics, although the relevant corrections to the electron-photon and electron- electron scattering are all of higher order. (J.R.D.)

16409 (TID-11030) REACTION STUDIES WITH FAST NEUTRONS. R. A. Peck, Jr. and D. R. Maxson (Brown Univ., Providence). Nov. 21, 1960. Contract AT(30-1)- 1082. 25p.

Spectra and angular distributions involving (n,d), (n,np), and (n,p) reactions on targets of Rh, In, Sb, Sn^{116}, and Sn^{120} are discussed. The (n,d) process is dominant for all ex- cept the Sn isotopes, requiring an extensive re-appraisal of spectra and cross sections heretofore attributed to (n,p). Angular distributions agree well with predictions and one new J^{π} assignment is made (1.88 Mev level in Ru^{102}, 0− or 1−). Systematic features of the interaction radius are noted. Predicted properties of (n,p) gross structure presented a variety of effects for experimental investigation. Study of compound nucleus (n,p) processes from ten target nuclei of the 3rd and 4th atomic shells is discussed. Temperatures, spin-dispersion values and fractions of direct contribution are in generally good agreement with independent determinations. (auth)

16410 (TID-12387) THE NEW ISOTOPE, Al^{30}. E. L. Robinson and O. E. Johnson (Purdue Univ., Lafayette, Ind.). [1961]. 26p. Contract [AT(11-1)-123].

Scintillation measurements were made of the beta and gamma radiation from high-purity natural silicon targets after bombardment with fast neutrons produced by the $Li^7(d,n)Be^8$ reaction ($E_n \lesssim 24$ Mev). In addition to well- known radiations, a beta spectrum with an end point of 5.05 ± 0.25 Mev and two gamma rays with energies of 2.26 ± 0.03 Mev and 3.52 ± 0.03 Mev were observed. These gamma rays and the beta group decayed, within experi- mental error, with the same half life, 3.27 ± 0.20 sec. The assignment of this activity to Al^{30} and the proposed decay scheme are supported by considerations involving the de- cay schemes of the well-known isotopes produced, half-life studies using portions of both the beta and gamma spectra, the features of experimental beta and gamma spectra, and nuclear systematics. Strong beta transitions to the first and second excited states of Si^{30} are inferred by the experi- mental gamma spectrum and nuclear systematics. A weak beta transition (~2%) to the ground state can not be ex- cluded by this investigation. Possible spin and parity as- signments for the ground state of Al^{30} are 1+, 2+, and 3+. A weak argument is made against a spin 1 assignment. The results of this investigation can not be used to reduce the ambiguity of the spin assignment further. The resulting $Al^{30}-Si^{30}$ mass difference is 7.29 ± 0.25 Mev. (auth)

16411 (TID-12494) SHORT-LIVED ISOMERS OF Ge^{71}, As^{74}, Br^{78}, AND Tc. A. W. Schardt and Albert Goodman (Los Alamos Scientific Lab., N. Mex.). 19p.

Short-lived isomers of Ge^{71}, As^{74}, Br^{78}, and Tc were pro- duced with the pulsed beam of a Van de Graaff generator

and observed between pulses with scintillation detectors. For Ge^{71}, the half-life was 20.3 ± 0.3 msec, the M2 transition was 23 kev, and the observed gamma ray had an energy of 175 kev. The half-life of the As^{74} isomer was 8.0 ± 0.3 sec. The M3 transition was 283 kev giving rise to a gamma ray with an energy of 283 ± 5 kev. The isomeric half-life of Br^{78} was found to be 118.0 ± 1.5 μsec, the M2 transition was 149 kev, and gamma rays with energies of 149 ± 2 and 32 ± 2 were observed. Two new isomers were assigned to technetium with half-lives of 8.15 ± 0.20 and 15.5 ± 0.8 μsec. The observed gamma rays had energies of 177 ± 4 and 42 ± 3, respectively. (M.C.G.)

16412 (UCRL-9130(Rev.)) THE Rb^{85}–Rb^{86} HYPERFINE–STRUCTURE ANOMALY. Norman Braslau, Gilbert O. Brink, and Jhan M. Khan (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1960. Contract W-7405-eng-48. 45p.

The atomic beam magnetic-resonance method with separated oscillatory fields was used to measure the hyperfine structure separation and magnetic dipole moment of the isotopes Rb^{85} and 18.6d Rb^{86} in the $^2S_{1/2}$ electronic ground state. Observation of the separation of a $\Delta F = \pm 1$ doublet in the intermediate field region gave the value of the moment; the minimum value of the mean doublet frequency gave the value of $\Delta\nu$. Observation of another $\Delta F = \pm 1$ doublet in low field also yielded a value for $\Delta\nu$. Results obtained for Rb^{85} are in good agreement with previously published values and indicate that transition frequencies calculated from the Briet-Rabi equation agree with experiment to at least one part per million. For Rb^{86} the following values were obtained for the $^2S_{1/2}$ ground state: $\Delta\nu = 3946.883(2)$ Mc, $g_I = -4.590(4) \times 10^{-4}$, and $\mu_I = -1.6856(14)$ nm (without diamagnetic correction). The hyperfine-structure anomaly arose in part from the difference of the volume distribution of nuclear magnetism in the two nuclei and is defined as the deviation from equality of the ratio of the hyperfine-splitting factors of two isotopes to the ratio of their nuclear g factors. For these two isotopes its value was found to be $^{85}\Delta^{86} = 0.17(9)\%$. The Bohr-Weisskopf theory of the hfs anomaly was applied to these isotopes with calculations based on a single particle model with varying distributions of spin and orbital contributions to the magnetic moment. (auth)

16413 (WAL-TR-819.3/1) TABLES OF PROTON ENERGIES AND MAGNETIC RIGIDITIES VERSUS DEUTERON ENERGIES FOR d-p REACTIONS ON LIGHT NUCLEI. Arnold W. Schultz and William Z. Leavitt (Watertown Arsenal Labs., Mass.). Feb. 1961. 69p. (PB-154849)

The emitted proton energy and magnetic rigidity are presented as a function of incident deuteron energy for the ground state d-p reaction on the light elements through neon. The deuteron energy range of 1.1 to 2.1 Mev is covered in 10 kev increments at laboratory reaction angles of 30, 60, 90 and 120 degrees. (auth)

16414 (TT-941) SHELL MODEL COUPLING AND POLARIZATION OF STRIPPING PROTONS. O. Hittmair. Translated by D. A. Sinclair from Z. Physik, 144: 449-54 (1956). 9p.

The polarization of the protons of a (d,p) reaction was calculated on the basis of a general intermediate coupling of the captured neutrons. In the numerical calculation of the polarization of $N^{13}(d,p)N^{14}$ protons the general expression was approximated, while the interaction between nucleus and proton was restricted to a pure potential scatter. The upper limit, ⅓ of the absolute value of the polarization, however, is strictly valid in any case. (auth)

16415 (TT-943) YIELD OF (d,2n) REACTIONS IN T CONTINUUM RANGE. O. Hittmair. Translated by D. A Sinclair from Z. Physik, 150: 648-52(1958). 8p.

This paper was previously abstracted from the origin language and appears in NSA, Vol. 12, abstract no. 9482.

16416 A PHENOMENOLOGICAL MODEL FOR HIGH ENERGY INTERACTIONS. I. MULTIPLICITIES AND CROSS SECTIONS. Kurt Sitte (Israel Inst. of Tech., Hai Bull. Research Council Israel. Sect. F, 9F: 93-110(Dec 1960). (In English)

In an attempt to investigate the possibility of deriving relevant features of nucleon-nucleon interactions at high energies from a purely phenomenological model, the inelasticities, cross sections and average multiplicities wer calculated for a number of cases. It is shown that model of overlapping fields, first introduced by Heisenberg, lea to excessively large values of the cross sections which a incompatible with experimental data. If, instead, the over lap volume of nucleons of tapered shape—approximated a Gaussian with $\alpha = 2$ outside of a constant-density regio of radius $r_0 = 0.75 \times 10^{-13}$ cm—is taken as a measure of the energy transfer, reasonable values for the cross sections are obtained. K-meson production of the right abundance can also be predicted by assigning it to a 'core' of radius $\sim\frac{1}{2}\, r_0$. But the average multiplicities increase to rapidly with the primary energy if the customary postulation of complete inelasticity for head-on collisions is maintained. This can be eliminated by assuming that the maximum possible energy transfer depends on the collisi time. Tentatively ascribing $k_{max} \approx 0.5$ to interactions at γ 10^5, satisfactory results for both cross sections and multiplicities were obtained. Some consequences of the model the energy spectrum of jets, the multiplicity distribution, and the characteristics of collisions at air shower energie are discussed. In the air shower region, the model permi at least in a qualitative way, the interpretation of the anom alous diurnal variations observed by McCusker, and of the occurrence of collimated groups of μ-mesons apparently created in the highest parts of the atmosphere. But in its present form it is probably still inadequate to describe precisely the longitudinal development of air showers near their origin. (auth)

16417 PARTICLES OF ABNORMALLY LONG PATH EMITTED BY POLONIUM SOURCES. [PART] II. M. M. Morand, Y. Baudinet, and L. Winand (Universite, Liège Bull. soc. roy. sci. Liège, 30: 11-16(1961). (In French)

It has been suggested that the particles of abnormally long path emitted by polonium sources are the result of (α,p) reactions on boron impurities. Sources of Po + B gave distribution curves of particle path length different from those obtained from Po sources. Po sources prepare by electrolytic deposition and by vapor deposition gave similar distribution curves for particle path length. It was assumed that the protons from the (α,p) reaction on boron were superposed on long paths having a different origin. (J.S.R.)

16418 THE FIRST EXCITED STATES OF EVEN-EVEN SPHERICAL NUCLEI. Robert Arvieu and Marcel Véneron (Laboratoire de Physique Nucléaire, Orsay, France). Compt. rend., 252: 670-2(Jan. 30, 1961). (In French)

By analogy with superconductivity (Compt. rend. 250, 2155 (1960)) a generalization of the Sawada method was proposed which permits the explicit obtention of some excited states from the residual interaction between the nucleons and the structure of the mean potential. A study was made of an effective interaction type which leads to a

e simple form of the hamiltonian and of the coupled
tions. The study is limited to a system of particles
ne same nature, and the notation is changed to recon-
it with that of Baranger. (J.S.R.)

19 STUDY OF THE 6.33-Mev LEVEL OF N^{15} BY
REACTION $N^{14}(d,p)N^{15}$. Serge Gorodetsky, Pierre
tz, Gabriel Bassompierre, and André Gallmann.
pt. rend., 252: 713-15(Jan. 30, 1961). (In French)
he measurement of the angular distribution of protons
m the 6.33-Mev level of N^{15} and of the p-γ angular cor-
ations leads to the value $J = {}^3/_2^-$ for the angular mo-
t and parity of this level. (tr-auth)

20 PRECISION IN THE APPROXIMATE CALCULA-
ON OF ENERGY LEVELS. Françoise Combet-Farnoux
Georges Allard. Compt. rend., 252: 999-1001(Feb. 13,
1). (In French)
General inequalities having, as a particular case, the in-
alities of Romberg and Weinstein are shown. A higher
it of the weight P_k of a rigorous wave function ψ_k was
ermined in the development of an approximate wave func-
n f. This weight is less than 0.5 if the inequality of Wein-
in is not verified. (tr-auth)

21 EFFECT OF AN EXTERIOR FIELD ON THE NU-
EAR RESONANCE OF THE NUCLEUS OF IRON-57 IN A
CAL FIELD OF YTTRIUM IRON GARNETS. Claude
bert. Compt. rend., 252: 1442-4(Mar. 6, 1961). (In
ench)
The nuclear resonance of the nucleus of Fe^{57} in the local
ld of the sites of the yttrium garnet and the iron garnet
s studied after having expelled the Bloch walls by a static
gnetic field. (tr-auth)

22 INVESTIGATION OF A DOUBLE γ EMISSION
THE 1.75-MEV MONOPOLAR TRANSITION OF Zr^{90}.
rge Gorodetzky, Gilbert Sutter, Raymond Armbruster,
ierre Chevallier, Pierre Mennrath, Fernand Scheibling,
d Jean Yoccoz. Compt. rend., 252: 1132-4(Feb. 20,
961). (In French)
It has been theoretically predicted that the 1.75-Mev
vel of Zr^{90} would be deexcited by double γ emission. An
perimental study was made to detect and measure this
uble emission. The 1.75-Mev peak was not detected and
s upper limit of detection was calculated. (J.S.R.)

6423 THE DIFFERENCE BETWEEN THE BINDING
NERGIES OF A NEUTRON OF EVEN-ODD NUCLEI AND
VEN-EVEN NUCLEI. Christian Ythier and Ruurd Van
ieshout. Compt. rend., 252: 1308-10(Feb. 27, 1961). (In
rench)
There is a systematic difference between the binding en-
rgy of a neutron of nuclei with odd mass and of neighbor-
ng even-even nuclei. A study is made to determine if there
s a relationship between these differences and the varia-
ion of E_{nn} as a function of N. It was found that E_{nn} has a
emarkable maximum for N = 40 and Z = 32 (Ge). The
ariation of E_{nn} has an unexpected minimum for N = 56 in
he case of Mo. There is also a minimum for N = 30 (Fe)
nd N = 52 (Sr and perhaps Kr). A fine structure appears
o be evident in the region $22 < N < 52$ by the presence of
secondary discontinuities. (J.S.R.)

16424 ANOMALIES IN THE ANGULAR DISTRIBU-
TIONS OF α PARTICLES INELASTICALLY SCATTERED
BY IRON-56 AND NICKEL-58. René Beurtey, Philippe
Catillon, Robert Chaminade, Monique Crut, Henriette
Faraggi, André Papineau, Jean Saudinos, and Jacques
Thirion. Compt. rend., 252: 1756-8(Mar. 20, 1961). (In
French)
The study of the angular distributions of α particles in-
elastically scattered by Fe^{56} and Ni^{58} showed that the Blair
theory does not permit the parity of the slightly excited
levels to be determined. This is not true for the more
strongly excited levels. This suggests that the two excita-
tion mechanisms are different. (tr-auth)

16425 ORIGIN OF AN INTENSE γ RAY CONNECTED
TO THE ABSORPTION OF SLOW NEUTRONS BY URANIUM-
235. Francis Netter, Charles Corge, Jean Julien, Vinh-
Dinh Huynh, and Joseph Morgenstern. Compt. rend., 252:
1759-61(Mar. 20, 1961). (In French)
The 4.49-Mev γ ray observed at Chalk River in the ab-
sorption of slow neutrons by U^{235} was studied by selecting
the neutrons by the time-of-flight method and thus distin-
guishing the resonances where radiative capture predomi-
nates. It appears that the γ spectrum from radiative
capture of neutrons in U^{235} has at 4.5 Mev an intense com-
ponent. (tr-auth)

16426 A SOURCE OF POLARIZED DEUTERONS AND
DETECTION OF POLARIZATION IN THE (d,T) REACTION.
H. Rudin, H. R. Striebel, E. Baumgartner, L. Brown, and
P. Huber (Universität, Basel). Helv. Phys. Acta, 34: 58-84
(1961). (In German)
The design, construction and test of a source of polarized
deuterons are described. Three hyperfine components of an
atomic deuterium beam are separated in a strong magnetic
quadrupole field. The beam then passes into a weak homo-
geneous field, where the atoms are ionized by electron
bombardment. The gas kinetics of the formation and the
polarization of the beam are discussed together with the
attendant technical problems of magnetic fields and vac-
uum. The atomic beam intensity is predicted from theory
and compared with the measured value. The ionization of
the atomic beam and the resulting deuteron polarization are
described. Calculations of the spin populations of the ion
beam and the resulting polarization are given. The tensor
polarization of the beam is measured with the T(d,n) He_4
reaction. The beam consists of 10^{-8} A of deuterons char-
acterized by $P_{33} = -0.245$. Experiments indicate the use-
fulness of the device as a source of polarized protons, if
the proton content of the residual gas is reduced. (auth)

16427 THE GAMMA-RAY SPECTROMETRY OF FIS-
SION PRODUCTS. I. CALCULATED ACTIVITIES AND
GAMMA-RAY SPECTRA OF U-235 FISSION PRODUCTS.
Ichiro Hattori (Ishikawajima-Harima Heavy Ind. Co., Ltd.,
[Japan]). J. At. Energy Soc. Japan, 3: 93-103(Feb. 1961).
(In Japanese)
The disintegration rates and photon emission rates were
calculated for products of U^{235} thermal neutron fission at
the following periods after fission: 1, 3, 7, 14, 30, 50, 100,
200 days and 1, 1.5, 2, 3, 5, 10 years. Information on total
chain yields was largely referred to Katcoff (1958). Decay
schemes were from Strominger, Hollander, and Seaborg
(1958). The distribution of independent yields was neglected.
The photons were classified into nine energy groups, cover-
ing the range 0.0 to 1.6 Mev, which correspond to the photo-
peaks in NaI(Tl) scintillation spectra. The total disintegra-
tion rates and the total photon emission rates were
calculated as functions of time after fission. All the results
were tabulated and compared with other published calcula-
tions. (auth)

16428 THE INDEPENDENT YIELD OF ^{96}Nb IN THE
THERMAL NEUTRON FISSION OF ^{233}U, ^{235}U, AND ^{239}Pu.
I. F. Croall (Atomic Energy Research Establishment, Har-
well, Berks, Eng.). J. Inorg. & Nuclear Chem., 16: 358-61
(Feb. 1961). (In English)
The independent yields of 23 hr niobium-96 in the thermal

neutron fission of U^{233}, U^{235}, and Pu^{239} were measured to test Wahl's hypothesis. Results expressed as fractions of the total chain yield are $(1.0 \pm 0.2)10^{-3}$, $(9.8 \pm 2.0)10^{-5}$, and $(6.2 \pm 1.0)10^{-4}$ for U^{233}, U^{235}, and Pu^{239} respectively. A plot of these yields on the charge distribution curve shows that the plutonium fission results fall considerably below the curve, just as do the uranium results. This would indicate that the favored 50-42 proton split is at any rate not an important factor in causing the low yield of 23 hr Nb^{96}. The low yield may be explained by the short half-life of the isomer of niobium-96 which makes the independent yield very difficult to determine. (N.W.R.)

16429 REGULARITIES INVOLVING $^{6}_{2}He$ AND $^{4}_{2}He$ AND THEIR POSSIBLE IMPLICATIONS FOR NUCLEAR STRUCTURE. L. H. Ahrens (Univ. of Cape Town). J. Inorg. & Nuclear Chem., 16: 368-9(Feb. 1961). (In English)

The great majority of the regularities are associated with increases of $_2He^6$(2p + 4n) sub-units as well as the more familiar $_2He^4$; the $_2He^6$ regularities involve a maximum of seven participants. A consideration of the regularities leads to the suggestion that if clusters occur in the nuclear surface, or within the structure, both $_2He^6$ and $_2He^4$ should be considered as possible clusters. The regularities indicate a threefold division of nuclei with respect to Z and N as follows: (a) up to Z = N = 20, with $_2He^4$ as the principal cluster, (b) Z = N = 20 to N = 50 as a transition region with $_2He^4$ and $_2He^6$ as clusters outside a closed shell, and (c) N = 50 to N = 152 with $_2He^6$ as the principal cluster after shell closure at N = 50. If it is assumed that heavy nuclei (N > 50) of a given type are built by adding $_2He^6$ to the nuclear surface, the rate of increase of N-Z is a little too rapid for stability to be maintained over a large range of Z and an examination of the $_2He^6$ regularities leads to the suggestion that one function of N = 82 and certain other significant neutron numbers may be to reduce neutron excess. (N.W.R.)

16430 THE NUCLIDE ^{182}Hf. W. H. Hutchin and M. Lindner (Univ. of California, Livermore). J. Inorg. & Nuclear Chem., 16: 369-70(Feb. 1961). (In English)

The nuclide hafnium-182 was made by thermal-neutron irradiation of hafnium oxide and was found to have a half-life of 8.5×10^6 years. A preliminary study was made of possible radiations associated with the nuclide. Observation of the growth of the tantalum-182 daughter by x-ray pulse-height analysis and by mass-spectrometric analysis is described. The saturation specific activity was 40 dis/min per mg of sample for hafnium-182. A small specimen of hafnium was found to contain 0.0088 atom per cent abundance at the mass 182 position. (N.W.R.)

16431 THE CROSS-SECTION FOR THE REACTION $Cs^{133}(n,\gamma)Cs^{134}$ IN THE NRX REACTOR. F. Brown, P. J. Campion, and B. H. Oliver (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Nuclear Energy, Pt. A. Reactor Sci., 13: 141-4(Jan. 1961). (In English)

The effective cross sections ($\hat{\sigma}$) and cadmium ratios (R_{Cd}) for the reaction $Cs^{133}(n,\gamma)Cs^{134}$ are measured in three different positions of the NRX reactor and the results are interpreted to give values for the 2200 m/sec cross section (σ_0) and the resonance integral (Σ). Measurements are made relative to the cross sections for the reaction $Co^{59}(n,\gamma)Co^{60}$. $\hat{\sigma}$ varies from 34 bn in a graphite shielded position outside the reactor calandria to 41 bn in a vacant fuel rod position. The values of σ_0 and Σ derived are 33.4 ± 2.6 bn and 370 ± 50 bn respectively, where Σ is evaluated from 0.5 ev upwards and includes the 1/v part. The errors are standard deviations and include the errors in the measurements and the errors in the input data; they do not include errors which could arise in the interpretation of the data. (auth)

16432 GAMMA RAYS FROM INELASTIC SCATTERING OF NEUTRONS BY Fe, Cu, Zn, Ge AND Se. Kazuaki Nishimura (Japan Atomic Energy Research Inst., Tokyo). J. Phys. Soc. Japan, 16: 355-67(Mar. 1961). (In English)

Gamma rays following inelastic scattering of 3.11 to 4.72 Mev neutrons by Fe, Cu, Zn, Ge, and Se are measured using a ring geometry arrangement. The excitation functions for the following gamma rays are observed: 0.844, 1.23*, 1.80*, 2.11*, and 2.56* Mev in Fe^{56}, 0.665, 0.965, and 1.33 Mev in Cu^{63}, 0.760 and 1.11 Mev in Cu^{65}, 0.810*, 0.995, and 1.81 Mev in $Zn^{64,66,68}$, 0.590 Mev in $Ge^{74,76}$, 0.830 Mev in Ge^{72}, 1.01 Mev in Ge^{76}, 0.560 Mev in Se^{76}, and 0.660 Mev in $Se^{76,78,80}$, respectively. The asterisk indicates the transition from the higher excited to the 1st excited state. An aspect of de-excitation of higher energy levels is also discussed by analyzing the ratio of probabilities of de-excitation through or bypassing the 1st excited state, as a function of the incident neutron energy. (auth)

16433 ANGULAR DISTRIBUTIONS AND EXCITATION FUNCTIONS OF THE $Be^9(d,p)Be^{10}$ GROUND-STATE REACTION. Toshiyuki Ishimatsu, Naoyuki Takano, Yuki Hachiya, and Takao Nakashima (Kyusyu Univ., Hukuoka, Japan). J. Phys. Soc. Japan, 16: 367-71(Mar. 1961). (In English)

Angular distributions and excitation functions of the $Be^9(d,p)Be^{10}$ ground-state reaction are studied in the deuteron energy range from 1.7 to 3.0 Mev. Six angular distributions are measured at deuteron energies of 1.74, 1.97, 2.24, 2.51, 2.73, and 3.03 Mev. Each angular distribution has a forward peak characteristic of the deuteron stripping process for $l_n = 1$. The yields in the backward directions, however, are predominant at the lower energies. The excitation curve taken at the laboratory angle of 30°, where the forward peak occurs in the angular distribution, shows a monotone and rather fast rise with deuteron energy. On the other hand, the excitation function of the total cross section of this reaction shows a comparatively slow variation and has a broad peak at about 2.1 Mev of deuteron energy. (auth)

16434 INELASTIC SCATTERING OF THE α-PARTICLES OF POLONIUM BY LITHIUM NUCLEI. Éva Csongor. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen). Közlemények, 2: 195-8(1960). (In Hungarian)

The energy of the γ-radiation of Li^7 was recently found to be 0.478 Mev. As previous workers used large-diameter Po sources which yielded a non-homogeneous α-beam, an attempt was made to improve the experimental conditions by preparing a point-like source, subliming a 6.6-mc Po preparation on a 3 mm diameter Pt–Ir disk. The source was then placed in the center of a 5-cm diameter Li_2CO_3 hemisphere, varying the pressure of the CO_2 gas to change the energy level of the α-radiation. The excitation function obtained on the basis of the γ-radiation showed a resonance structure at 2.9 ± 0.1 and also at 3.9 ± 0.2 and 4.6 ± 0.2 Mev although the last two figures include relatively large statistical errors. According to H. Bichsel and T. W. Bonner (Phys. Rev., 94: 1023(1957)) these resonances are due exclusively to the inelastic scattering of α-particles. (TTT)

16435 STUDIES ON THE EXCITATION FUNCTION OF THE $Na^{23}(\alpha,p)Mg^{26}$ NUCLEAR REACTION. István Angeli. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen). Közlemények, 2: 199-204(1960). (In Hungarian)

In investigating the highly excited states of the Al^{27} nucleus formed in $Na^{23}(\alpha,p)Mg^{26}$, the intensity of the γ-radiation of the end member was determined as a function of the energy of the incident α-particles. By exposing a NaCl target to the α-radiation of Po, following the experimental

ils given in the previous article, 4 resonances were d at E_α = 5.275, 5.220, 5.165, and 5.130 ± 0.015 Mev, esponding to the E^+ = 14.589, 14.542, 14.495 and 65 ± 0.013 Mev energy states of the Al^{27} nucleus. From γ-spectrum thus obtained it is concluded that the radia- is generated by the $Na^{23}(\alpha,p)Mg^{26}$ reaction. (TTT)

36 ACTIVITIES OBSERVED IN IRIDIUM AFTER UTRON BOMBARDMENT. Gertrude Scharff-Goldhaber Michael McKeown (Brookhaven National Lab., Upton, Y.). Naturwissenschaften, 48: 96-7(1961). (In English)
ecently Hennies and Flammersfeld (Naturwissen- aften, 47: 11(1960)) reported the observation of a new sec activity produced by irradiating Ir powder with wed-down neutrons. The activity was tentatively as- ned to Ir^{194m}. Beta activities, previously ascribed to ^{2m}, were reassigned to Ir^{194m}. A repetition of the ex- iment on the bombardment of Ir^{193} with slow neutrons ys. Rev. Letters, 3: 48(1959)) confirmed the previous clusions and ruled out a 47-sec period in Ir^{192} or Ir^{194}. was suggested that the Hennies and Flammersfeld re- ts may be partly ascribed to a Rh impurity and partly the effect of fast neutrons. (J.S.R.)

437 EFFECTS OF THE NUCLEAR BINDING OF NU- EONS ON PION SPECTRA. G. Gel'fer (H. Helfer), A. S. znetsov, M. G. Mescheryakov, V. Svyatkovskii (W. iatkowski), and V. G. Vovchenko (Joint Inst. for Nuclear search, Dubna, USSR). Nuclear Phys., 23: 353-68 ar. 1961). (In English)
Using a magnetic spectrometer a comparative study was ade of the energy spectra of π^+ and π^--mesons produced free pp-collisions as well as in pp- and pn-collisions in uterons and in carbon nuclei at 654 Mev. The forms of e spectra of pions from deuterium and carbon are found differ due to: a) a larger extent of correlation of nu- eons in carbon nuclei than in deuterons; b) differences the momentum distributions of nucleons in these nuclei; secondary pion-nucleon interactions in carbon nuclei. At 90° in the center-of-mass system of two colliding nucleons e ratio of the differential cross sections for the production π^+-mesons on free protons and on protons in deuterons nd in carbon nuclei was found to be equal to $(d\sigma/d\omega)\,[p + p \to \pi^+]_H : (d\sigma/d\omega)\,[p+p \to \pi^+]_D : (d\sigma/d\omega)\,[p + p \to \pi^+]_C = 1 : 1.79 : 0.40$, whereas the yields of π^--mesons per neutron or deuterium and carbon were found to be equal. The measured ratio $(d\sigma^+/d\omega)/(d\sigma^-/d\omega)$ of the differential cross sections for the production of positive and negative pions in deuterium and carbon is equal to 10.3 ± 1.3 and 6.0 ± 0.8, respectively. The decrease of the value of this ratio for carbon is caused by a considerable contribution of the secondary exchange interaction $\pi^0 + n \to \pi^- + p$ to the yield of π^--mesons. (auth)

6438 ANGULAR DISTRIBUTION AND POLARIZATION OF THE NEUTRONS EMITTED IN μ-CAPTURE IN CERTAIN LIGHT NUCLEI. M. K. Akimova, L. D. Blokhintsev, and I. I. Dolinskii (Dolinsky) (Moscow State Univ.). Nuclear Phys., 23: 369-85(Mar. 1961). (In English)
Calculations of the energy spectra, angular distributions and polarization of direct process neutrons formed in μ-capture in the nuclei of C^{12}, Ne^{20}, Si^{28}, and S^{32} are performed on the basis of the effective Hamiltonian for μ-capture taking account of relativistic effects of first order with respect to v/c for nucleons, including "weak magnetism" and effective pseudoscalar interaction. The proton states in the nucleus was described by the nuclear shell model with jj-coupling; the interaction of the emitted neutrons and the nuclei was taken into account via an optical model. The results obtained are compared with experimental data. (auth)

16439 SOME $Be^9(d,p\gamma)Be^{10}$ ANGULAR CORRELATION MEASUREMENTS OFF THE STRIPPING PEAK. F. H. Read, J. M. Calvert, and G. Schork (Manchester Univ., Eng.). Nuclear Phys., 23: 386-98(Mar. 1961). (In English)

Angular correlations, in the reaction and azimuthal planes, between protons and gamma rays from the first excited state of Be^{10} in the reaction $Be^9(d,p\gamma)Be^{10}$, were measured for four proton angles between 26° and 86° in the center-of-mass system. For a pure stripping reaction, with l = 1 for the stripped neutron, only $P_2(\cos\theta_{p\gamma})$ terms are allowed in the angular correlation function in the reaction plane. However, P_4 terms were found even on the stripping peak, indicating a compound-nucleus contribution to the reaction. Excitation functions for the reaction products of Be^9 + d were measured for incident energies from 3.8 to 6.3 Mev and these show an absence of resonances. Absolute differential cross-sections for the ground state and first excited state proton groups from the $Be^9(d,p)Be^{10}$ reaction were measured at an incident energy of 5.86 Mev; these were analyzed in terms of the Butler stripping theory to give cut-off radii and reduced neutron widths. (auth)

16440 ALPHA-DEUTERON MODEL OF THE Li^6 NUCLEUS. T. I. Kopaleishvili, I. Sh. Vashakidze, V. I. Mamasakhlisov, and G. A. Chilashvili (Physical Inst. of the Acad. of Sciences of the Georgian Republic, Tbilissi, Georgian SSR). Nuclear Phys., 23: 430-8(Mar. 1961). (In English)

The stability conditions are investigated for a system of three protons and three neutrons creating subsystems with four or more nucleons in the form of an α-particle and a deuteron, respectively. It is shown that the 3.87 Mev level of the nucleus of Li^6 can be obtained via the transition of a deuteron in the nucleus from a triplet into a single state. (auth)

16441 ON PROCESSES IN THE INTERACTION OF γ-QUANTA WITH UNSTABLE PARTICLES. I. Ya. Pomeranchuk (Theoretical and Experimental Physics Inst., Moscow) and I. M. Shmushkevich. Nuclear Phys., 23: 452-67(Mar. 1961). (In English)

Various inelastic processes occurring in the collisions of fast particles with the nuclei neither excited nor transformed are treated. At $q^2 = 0$ (q^2 being the invariant square of the momentum transfer to the nucleus) the amplitude of these processes has a pole involving virtual photons. Therefore at sufficiently small q^2 the virtual photon exchange makes a larger contribution to the amplitude than the exchange of strongly interacting particles. This makes it possible to connect at small q^2 the cross section of the process under study and that of the process at work between the γ-quantum and the incident particle. Given q^2 and $E_L \gg m$ (E_L being the energy of incident particle in the laboratory coordinate system and m its mass), the energy w of the particles produced in the reaction in their center-of-mass system is restricted by the condition $w^2 - m^2 < 2E_L\sqrt{q^2}$. The relation between the above-mentioned cross sections, equivalent to one following from the Weizsäcker-Williams method, is obtained by a covariant method, and the conditions of applicability of this relation are discussed, in particular for strongly interacting particle processes. An appraisal is made of the contribution made by the processes involving the Coulomb nuclear field to the total cross section of interaction between the incident particle and the nucleus. The processes at work in the Coulomb field of the nucleus, such as the bremsstrahlung of π or K-mesons, the conversion of π-mesons into two π-mesons and the transformations of a Λ^0-particle into Σ^0-particle are analyzed in detail. (auth)

16442 CROSS SECTIONS FOR THE (γ,n) REACTION IN Cu^{63}, Cu^{65}, Zn^{64}, Sb^{121} AND Pr^{141}, MEASURED WITH MONOCHROMATIC GAMMA RAYS. G. E. Coote, W. E. Turchinetz, and I. F. Wright (Australian National Univ., Canberra). Nuclear Phys., 23: 468-80(Mar. 1961). (In English)

Cross sections for the (γ,n) reaction in Cu^{63}, Cu^{65}, Zn^{64}, Sb^{121}, and Pr^{141} were measured using gamma rays from the $Li^7(p,\gamma)Be^8$ and $B^{11}(p,\gamma)C^{12}$ reactions. NaI(Tl) crystals were used to monitor the radiation and to measure the residual activity. The $Cu^{63}(\gamma,n)Cu^{62}$ cross section for the lithium radiation from the 440 kev resonance is 59 ± 6 mb. The cross sections at 12.2, 14.8, 16.7, and 17.6 Mev are then 11 ± 2, 33 ± 4, 63 ± 8, and 73 ± 8 mb, respectively. These results confirm the bremsstrahlung measurement of the shape of the cross section but the absolute cross section values are 25% lower. Cross sections for the lithium resonance radiation, measured relative to that of Cu^{63}, are: Cu^{65}, 70 ± 7 mb; Zn^{64}, 40 ± 4 mb; Sb^{121}, 122 ± 13 mb; Pr^{141}, 181 ± 20 mb. Comparison with previous results suggests that discrepancies are due to inaccuracies in absolute β-counting. (auth)

16443 ISOMERIC STATES OF THE SPHERICAL NUCLEI OF Eu^{147}, Eu^{149} AND Eu^{151}. E. E. (Ye.) Berlovich, V. N. Klementyev, L. V. Krasnov, M. R. Nikitin, and I. Yursik (Physical-Technical Inst., Leningrad). Nuclear Phys., 23: 481-90(Mar. 1961). (In English)

Half-lifes of the $h_{11/2}$ levels of Eu^{147}, Eu^{149}, and Eu^{151} are measured and the following respective values obtained: $T_{1/2} = (7.1 \pm 0.4) \times 10^{-7}$ sec, $T_{1/2} = (2.48 \pm 0.05) \times 10^{-6}$ sec, and $T_{1/2} = (5.8 \pm 0.3) \times 10^{-6}$ sec. The M2-type transitions from the $h_{11/2}$ levels prove retarded, the degree of retardation increasing with the number of neutrons from 84 to 88. The E3-type transition rates in the nuclei of Eu^{147} and Eu^{149} prove close to one-particle evaluations. The results of the present investigation, together with the data, contradict the analysis performed by Nilsson and Gottfried on the motion of an odd proton of Eu^{151} in a deformed potential. (auth)

16444 BREAKUP OF DEUTERONS ON H, D, He^3 AND He^4. B. V. Rybakov, V. A. Sidorov, and N. A. Vlasov (Kurchatov Atomic Energy Inst., Academy of Sciences, Moscow). Nuclear Phys., 23: 491-8(Mar. 1961). (In English)

Continuous neutron energy spectra produced by bombardment of H, D, He^3, and He^4 with 18.6 Mev deuterons and D with 8.6 Mev protons and 34.6 Mev alpha particles were studied by the time-of-flight technique. Peaks in the neutron spectra from the p + d and α + d reactions were observed which are satisfactorily explained by pair interactions between the reaction products in the final state. No such peaks were found in the spectra of the d + d and He^3 + d reactions. Their shape also differs significantly from that corresponding to the statistical distribution of energy between the three particles in S-states of relative motion, but can be easily explained by the presence of higher angular momenta in the final state. (auth)

16445 AN INVESTIGATION OF NUCLEAR PROBES. P. E. Hodgson (Clarendon Lab., Oxford). Nuclear Phys., 23: 499-505(Mar. 1961). (In English)

The optical model is used to study the sensitivity to the outer regions of the nuclear field of the elastic differential cross-sections for the scattering of neutrons, protons, deuterons, tritons, helium-3, and alpha particles by nuclei. It is found that the energy at which the sensitivity is greatest is given approximately by $ZZ'|A^{1/3}$ Mev, where Z and A refer to the target nucleus, and Z′ to the probe particle. (auth)

16446 WIGNER CONDITION AND LOW ENERGY SCATTERING. P. Menotti and Y. Tomozawa (University Coll., London). Nuclear Phys., 23: 506-12(Mar. 1961). (In English)

Relations between the interaction range, effective range and scattering length for s- and p-waves are derived by using Wigner's inequalities for the momentum derivative of the scattering phase shift. Applications to $\pi-N$ and $n-p$ scattering are given. In particular it is shown that the obtained value ($R \geq 0.68\ \hbar/\mu c$) for lower limit of the interaction range for s-wave ($T = 3/2$) in $\pi-N$ scattering might support the existence of $\pi-\pi$ interaction. (auth)

16447 ENERGY DEPENDENCE OF THE CROSS SECTION OF THE NUCLEAR REACTION $O^{16}(\gamma,n)O^{15}$. L. Keszthelyi, I. Berkes, I. Demeter, and I. Fodor (Central Research Inst. for Physics, Budapest). Nuclear Phys., 23: 513-17(Mar. 1961). (In English)

The resonances in the $O^{16}(\gamma,n)O^{15}$ reaction at 17.55 Mev and 17.68 Mev were investigated with the γ-radiation of $Li^7(p,\gamma)Be^8$ reaction. It was found that if these levels exist at all their width exceeds ≈150 kev. (auth)

16448 THE $B^{11}(p,\gamma\alpha)Be^8$ REACTION AND THE 9.63 Mev STATE OF C^{12}. A. G. Gregory (Australian National Univ., Canberra). Nuclear Phys., 23: 518-23(Mar. 1961). (In English)

An attempt to measure the cross section for transitions between the 16.11 and 9.63 Mev states of C^{12} is reported and an upper limit of 30% of that for ground state transitions is given. Theoretical formulas are given for the observable coincidence rate in the $B^{11}(p,\gamma\alpha)Be^8$ reaction at 163 kev bombarding energy as a function of γ detector acceptance angle for two positions of this detector. These formulas are used in conjunction with experimentally determined background rates to assess the possibility of determining the spin of the 9.63 Mev state of C^{12} by means of angular correlation measurements. (auth)

16449 DIFFERENCES IN NATURAL WIDTHS OF CONVERSION LINES. J. H. Dijkstra and C. De Vries (Inst. for Nuclear Research, Amsterdam). Nuclear Phys., 23: 524-31(Mar. 1961). (In English)

A folding procedure was applied to K- and L-conversion line pairs due to gamma-ray transitions in Hg- and Bi-isotopes, measured with an ironfree double focussing beta-ray spectrometer. Apart from yielding an accurate determination of the $B\rho$-ratio of corresponding K- and L-lines this procedure indicated the difference of the atomic level widths to be 49 ± 5 ev in Bi and 54 ± 5 ev in Hg, in fair agreement with x-ray data. (auth)

16450 COULOMB EXCITATION OF Se^{77}. W. R. Wisseman and R. M. Williamson (Duke Univ., Durham, N. C.). Nuclear Phys., 23: 532-6(Mar. 1961). (In English)

The 240- and 442-kev levels in Se^{77} were excited with 4.0-Mev protons and 3.5-Mev deuterons, and the scattered particles were observed at angles of 150° and 145°, respectively. They were studied with a magnetic analyzer and detected by photographic plates. The B (E2) values which were obtained were 0.17 ± 0.02 and 0.26 ± 0.03 for the 240- and 442-kev levels, respectively. The ratio of these B (E2) values, 1.5 ± 0.2, is in good agreement with the ratio of 1.5 which is predicted by the unified model for rotational states and spin assignments ($1/2$, $3/2$, $5/2$) for the ground, 240- and 442-kev states. (auth)

16451 VIRTUAL LEVELS IN THE VANADIUM ISOTOPES FROM PROTON BOMBARDMENT OF THE TITANIUM ISOTOPES. J. DuBois (Chalmers Univ. of Tech., Gothenburg). Nuclear Phys., 23: 357-58(1961). (In English)

Electromagnetically separated Ti-isotopes were bombarded by protons in the 800 to 1400 kev interval. From the (p,γ) resonances the virtual levels in the V-isotopes were determined. Levels spacings are discussed. (auth)

16452 SODIUM-24 EXCITATION FUNCTION FOR MAGNESIUM-6 IONS ON ALUMINIUM. Inge-Maria Ladenbauer (Yale Univ., New Haven). Nuclear Phys., 23: 559-71(1961). (In English)

The excitation function for the reaction $Al^{27}(Li^6; 5p, n)Na^{24}$ was measured using the stacked foil technique. The large constant cross section of 43 mb over the energy region from 37 to 63 Mev total beam energy makes this reaction suitable for beam flux monitoring in other nuclear chemical studies. (auth)

16453 THE SCATTERING OF HIGH ENERGY NUCLEONS BY COMPLEX NUCLEI. C. J. Batty (National Inst. for Research in Nuclear Science, Harwell, Berks, Eng.). Nuclear Phys., 23: 562-93(1961). (In English) (NIRNS/R/1)

An analysis of nucleon-carbon scattering experiments in the energy range 90 to 1000 Mev was made in terms of the Optical Model using the semi-classical approximation. Values of the differential cross section and polarization at a number of angles and the absorption and total cross sections were used in obtaining parameters given a "best-fit" to the experimental data. The analysis was made for protons of energies 95, 135, 155, 220, 310, 420, 635, and 970 Mev and for 155 Mev neutrons. Calculations at various energies were also made using Optical Model potentials obtained by other workers from nucleon-nucleon scattering data. (auth)

16454 SYMPLECTIC INVARIANTS AND FLOWERS' CLASSIFICATION OF SHELL MODEL STATES. K. Helmers (Institut fur Experimentalphysik, Hamburg). Nuclear Phys., 23: 594-611(1961). (In English)

Flowers has given a classification of shell model states in j−j coupling for a fixed number of nucleons in a shell with respect to a symplectic group. The relation between these classifications for the various nucleon numbers is studied and is found to be governed by another symplectic group, the transformations of which in general change the nucleon number. (auth)

16455 THE MOMENT OF INERTIA OF ROTATING NUCLEI. Amnon Katz (Weizmann Inst. of Science, Rehovoth, Israel) and John Blatt. Nuclear Phys., 23: 612-29(1961). (In English)

A method developed for superconductivity, and the Meissner effect is applied to the calculation of the rotational moment of inertia of superfluid systems. It is checked that the correct mass is obtained in an analog translational problem. The expressions for the moment of inertia are equivalent to those of A. B. Migdal. (auth)

16456 NEUTRON-GAMMA ANGULAR CORRELATION STUDIES OF THE $B^{11}(d,n\gamma)C^{12}$ REACTION. J. B. Garg, N. H. Gale, and J. M. Calvert (The University, Manchester, Eng.). Nuclear Phys., 23: 630-47(1961). (In English)

Several (n,γ) angular correlations of the neutron group leading to the 4.43 Mev level in C^{12} and the associated γ rays from the reaction $B^{11}(d,n)C^{12}$ were measured using time-of-flight techniques. The energies of the incident deuterons were 2.65 and 5.35 Mev, and the angles of the outgoing neutron direction were chosen at intervals of about 20°. The results of these measurements clearly show that the simple theory of Butler stripping is quite inadequate to describe the detailed features of the reaction mechanism but that good qualitative agreement of the results might be obtained with the distorted wave theory. Moreover the (n,γ) angular correlation measurements for backward angles of the neutrons do not show the expected features of the heavy particle stripping mechanism, which was used by other authors to account for the intensity of neutrons emitted at backward angles. (auth)

16457 THE $C^{12}(d,n)N^{13}$ REACTION UP TO 1.35 MeV. A. N. James (Cavendish Lab. Cambridge, Eng.). Nuclear Phys., 23: 648-56(1961). (In English)

Angular distributions and excitation functions were measured for the ground state neutron group in $C^{12}(d,n)N^{13}$ in the energy range E_d = 0.7 to 1.35 Mev. The results are interpreted in terms of compound nucleus formation. A comparison with $C^{12}(d,p)C^{13}$ is made. (auth)

16458 'HAMMER' TRACES EMITTED FROM NUCLEAR DISINTEGRATIONS PRODUCED BY 4.6 GeV/c MESONS. G. C. Deka (Univ. of Bristol, Eng.), D. Evans, D. J. Prowse, and M. Baldo-Ceolin. Nuclear Phys., 23: 657-66(1961). (In English)

Results are given concerning the energy and angular distribution of Li^8 fragments produced from interactions of 4.6 Bev/c π^- mesons with heavy nuclei in emulsions. It is shown that the frequency of Li^9 and Be^8 is low and that the Li^8 production cannot be completely described in terms of evaporation theory. The energy distribution of α particles from Li^8 decay is given and its interpretation discussed. (auth)

16459 NOTE ON THE α PARTICLE ENERGY SPECTRUM IN Li^8 DECAY. G. N. Fowler and T. W. Preist (Univ. of Bristol, Eng.). Nuclear Phys., 23: 667-71(1961). (In English)

An attempt is made to correlate the asymmetry in the energy distribution of α particles from Li^8 decay with the asymmetry in the behavior of the phase shift in the J = 2 state. A phenomenological potential of the Haefner type is used and the nuclear matrix element is evaluated using the mean value theorem. It is found that the two sets of data can only be correlated if the repulsive core is weakened as the energy increases. (auth)

16460 SCATTERING OF HIGH ENERGY POLARIZED DEUTERONS BY CARBON. B. A. Robson (Australian National Univ., Canberra). Nuclear Phys., 23: 672-80(1961). (In English)

It is shown that the inclusion of a small tensor force in the effective deuteron-carbon potential gives a more satisfactory description of the tensor components of polarization. (auth)

16461 THE SCATTERING OF NUCLEONS BY NUCLEI AT VERY HIGH ENERGIES. L. R. B. Elton (Battersea College of Tech., London). Nuclear Phys., 23: 681-93 (1961). (In English)

Experimental results on the scattering of neutrons by nuclei in the energy region 0.3 to 5.0 Bev are analyzed in terms of a semi-classical approximation, and this is compared with the classical treatment used in an earlier paper. The analysis is used to derive half-way radii of the nuclear density distributions and these are compared with the corresponding quantities obtained from electron scattering. An estimate is given of the magnitude of the depth of the real part of the optical potential in the energy region. (auth)

16462 LIFETIME OF THE 3.56 MeV LEVEL OF Li^6. I. Sh. Vashakidze, T. I. Kopaleishvili, and G. A. Chilashvili (Physical Inst., Academy of Sciences, Tbilissi, Georgian SSR). Nuclear Phys., 23: 694-5(1961). (In English)

Using isobaric invariance, the lifetime τ of the excited state of Li^6 with the excitation energy of 3.56 Mev is calculated by means of the matrix elements of the β decay He^6 →

Li^6. The calculation yields $\tau \approx 0.8 \times 10^{-17}$ sec, which is roughly $^1/_{10}$ of the experimental result. (auth)

16463 VIBRATIONS OF SPHERICAL NUCLEI. G. E. Brown (NORDITA, Copenhagen), J. A. Evans, and D. J. Thouless. Nuclear Phys., 24: 1-17(1961). (In English)

The particle-hole interaction is discussed as the mechanism for producing vibrational states in nuclei. The procedure is first illustrated by means of a schematic model, from which it is shown that the usual type of shell-model calculation must be extended to include correlations in the ground state of the nucleus before it can be applied to the calculation of vibrational states. Results of calculations in j−j coupling, but with zero-range forces, are given. (auth)

16464 A ROTATIONAL MODEL FOR Fe^{57}. R. D. Lawson and M. H. MacFarlane (Argonne National Lab., Ill.). Nuclear Phys., 24: 18-27(1961). (In English)

A model of Fe^{57} is examined, in which the odd neutron is considered to move in the field of an axially symmetric rotor. The effect of band mixing is included. For a prolate deformation with δ from 0.15 to 0.2, reasonable agreement with experiment is obtained for many of the properties of the states below 1 Mev in Fe^{57}. However, properties which depend on the intrinsic wave function of the $^1/_2^-$ ground state are in serious disagreement with experiment. The predictions of the model are insensitive to reasonable changes in the moment of inertia of the rotor and in the parameters (other than the deformation) characterizing the shape of the Nilsson potential. (auth)

16465 THE $C^{12}(p,pn)C^{11}$ AND $Al^{27}(p,3pn)Na^{24}$ CROSS-SECTIONS AT 591 MEV. K. Goebel, D. Harting, J. C. Kluyver, A. Kusumegi, and H. Schultes (CERN, Geneva). Nuclear Phys., 24: 28-35(1961). (In English)

The absolute cross sections of the reactions $C^{12}(p,pn)C^{11}$ and $Al^{27}(p,3pn)Na^{24}$ were measured by exposing polythene and aluminum targets to the 591-Mev external proton beam of the CERN synchrocyclotron. The proton flux was measured with a secondary emission chamber, calibrated by a counter telescope technique. The C^{11} and Na^{24} activity, induced in the targets, was determined by conventional counting methods, using calibrated Na^{22} and Na^{24} sources as primary standards. The measured cross sections are 29.9 ± 1.5 mb and 11.0 ± 0.5 mb for the reactions $C^{12}(p,pn)C^{11}$ and $Al^{27}(p,3pn)Na^{24}$, respectively. (auth)

16466 SIMPLIFIED DISCUSSION OF BACKWARD PEAKING IN DIRECT INTERACTIONS. A. J. Kromminga and I. E. McCarthy (Univ. of Adelaide). Nuclear Phys., 24: 36-42 (1961). (In English)

A systematic semi-quantitative understanding of the shape and energy variation of the large backward peaks often observed in the angular distributions of products of direct interactions is given by the distorted wave Born approximation for a normal stripping-type process. The peaks are seen to result from the overlapping of the foci in the optical model wave functions for the positive energy particles as the scattering angle approaches 180°. The energy variation has the same period as would be given by $[jL(kr_0)]^2$ but is displaced considerably in phase. (auth)

16467 A SEARCH FOR PARITY-FORBIDDEN ALPHA-DECAY FROM THE 8.88 MEV (2^-) STATE IN O^{16}. W. Kaufmann and H. Wäffler (Max-Planck-Institut für Chemie, Mainz). Nuclear Phys., 24: 62-8(1961). (In English)

The parity-forbidden α decay of the O^{16} 8.88-Mev (2^-) state into $C^{12} + \alpha$ has been proved to be less frequent than the α decay of the 9.58 (1^-) state by a factor $<1.4 \times 10^{-6}$. From this experimental fact, an upper limit for the intensity F^2 of a possible opposite parity admixture to the 8.88-Mev state in O^{16} can be derived. It depends on the assumption made about Γ_α, the level width of a hypothetical 8.88-Mev (2^+) state in O^{16} and ranges between $F^2 \leqq 1.3 \times 10^{-12}$ to 1.3×10^{-11} according to Γ_α = 6 kev to 0.6 kev. (auth)

16468 RESIDUAL INTERACTION AND THE DEFORMATION OF NUCLEI. Akito Arima (Argonne National Lab., Ill.). Nuclear Phys., 24: 69-83(1961). (In English)

The influence of short-range (delta-function) two-body interactions on the equilibrium deformation of nuclei at the beginning of the (2s−1d) shell was studied. The moment of inertia, the equilibrium deformation, and the energy of β vibrations were calculated as a function of the strength of the interaction. (auth)

16469 EFFECTIVE CROSS SECTIONS FOR THE REACTIONS (p,n) AND (p,2n) ON Nd^{150}. J. Olkowsky, I. Gratot, and M. Le Pape (Centre d'Etudes Nucleaires, Saclay, France). Nuclear Phys., 24: 84-8(1961). (In French)

Absolute cross sections were measured for the reactions $Nd^{150}(p,n)Pm^{150}$ and $Nd^{150}(p,2n)Pm^{149}$ ($E_p \leqq 11.1$ Mev). The sum of these cross sections is compared to that obtained by means of optical model. The agreement is satisfactory. By using a simple model of evaporation, theoretical excitation functions are obtained which render a good account of experimental results. (auth)

16470 γ RAYS FROM AN EXTRANUCLEAR DIRECT CAPTURE PROCESS. R. F. Christy (Inst. for Advanced Study, Princeton, N. J.) and Ian Duck. Nuclear Phys., 24: 89-101(1961). (In English)

Direct electric dipole capture γ-ray transitions are calculated for a number of cases of charged-particle capture in nuclei. It is found that when the γ-ray energy is sufficiently low, below about 2 Mev, the capture matrix element is determined by regions external to the usual "nuclear radius". A number of cases of this type are discussed and the calculations are compared with experiment. The calculations are extended to the kev region in those cases when the process is of astrophysical interest. (auth)

16471 THE POLARIZATION OF PROTONS $Be^9(d,p)Be^{10}$ AND $Li^6(d,p)Li^7$ FOR 1.63 MEV DEUTERONS. A. M. K. Van Beek and G. O. André (Norges Tekniske Høgskole, Trondheim, Norway). Nuclear Phys., 24: 102-6(1961). (In English)

The degree of polarization of the ground state protons of Be^{10} when Be^9 is bombarded with 1.63-Mev deuterons was found to be P = +1% ± 7% at an angle of 40°. Although the statistics in the lithium reaction are very poor, the degree of polarization is estimated to be −48% ± 16% and −63% ± 14% for the ground state and first excited state protons, respectively, at 40°. (auth)

16472 (d,α) REACTIONS ON SOME LIGHT NUCLEI AT 13 MEV. N. Cindro (Ruder Boskovic Inst., Zagreb), M. Cerineo, and A. Strzałkowski. Nuclear Phys., 24: 107-17(1961). (In English)

Angular distributions of α particles from the reactions $B^{10}(d,\alpha)Be^8$, $B^{10}(d,\alpha)Be^{8*}$, $F^{19}(d,\alpha)O^{17}$, and $F^{19}(d,\alpha)O^{17*}$ were studied with 13-Mev deuterons by means of thin scintillator technique. The results for B^{10} and F^{19} show a forward peaked distribution. An attempted fit in terms of the Butler theory indicates the predominancy of direct processes in the mechanism of these reactions. The angular distribution for the reaction $Al^{27}(d,\alpha)Mg^{25}$ was measured. In this case it was not possible to separate the ground state from the low-lying excited states of Mg^{25}. The absolute values of differential cross sections were measured in all cases. (auth)

473 TRANSITIONS BETWEEN LOW-LYING EXTED STATES OF Mn^{56} AND Ho^{166}. I. V. Estulin, A. S. lioranskii (Melioransky), and L. F. Kalinkin (Moscow te Univ.). Nuclear Phys., 24: 118-25(1961). (In Engh)

The measurement of coincidences of cascade quanta is ed as a technique for investigating the low-lying levels odd nuclei of Mn^{56} and Ho^{166} arising in the radiative cape of thermal neutrons. Reduced probabilities of M1 and mixed radiative transitions with energies of 25 and 85 v are found for Mn^{56}. The rotational band 0^-, 2^- (54.2 v), and 4^- (174 kev) is detected in the strongly deformed cleus Ho^{166}. (auth)

6474 ANGULAR DEPENDENCE OF β-γ CORRELATION IRCULAR POLARIZATION) IN Au^{198}. J. P. Deutsch and . Lipnik (Université Catholique, Louvain, Belg.). Nuclear hys., 24: 138-42(1961). (In French)

Angular dependence of the beta-gamma circular polarizaon correlation in Au^{198} was measured. It can be described y a cosine function, which is the prediction of the so-called ξ-approximation". A limit to a possible P_3-term in the istribution function is set by the ratio $A_3/A_1 = -0.13 \pm .25$. (auth)

6475 γ-γ ANGULAR CORRELATION IN THE $Ti^{48}(n,\gamma)Ti^{49}$ REACTION. B. Kardon, D. Kiss, I. Lovas, nd Z. Zámori (Central Research Inst. for Physics, Budaest). Nuclear Phys., 24: 151-9(1961). (In English)

The angular correlation of the γ radiation resulting from he $Ti^{48}(n,\gamma)Ti^{49}$ reaction was measured for 0.34–1.38 Mev and 1.38–6.43 Mev cascades. The spin values of the 1.38 and 1.72 Mev levels of Ti^{49} as well as the multipolarity of he 0.34 Mev transition were determined. (auth)

16476 RELATIVISTIC ONE-PION EXCHANGE NUCLEAR POTENTIAL. Suraj N. Gupta (Wayne State Univ., Detroit). Nuclear Phys., 24: 160-2(1961). (In English)

The exact relativistic one-pion exchange nuclear potential is derived in the center-of-mass system, and the relationship between the relativistic potential and the Schroedinger equation is discussed. (auth)

16477 ON THE SPIN DEPENDENCE OF NEUTRON STRENGTH FUNCTIONS. Kamal K. Seth (Duke Univ., Durham, N. C.). Nuclear Phys., 24: 169-75(1961). (In English)

The possibility of J dependence of s-wave neutron strength function S is examined empirically (a) by comparing adjoining odd-mass ($I \neq 0$) and even ($I = 0$) nuclei, (b) by requiring that the strength function should vary smoothly with atomic weight for adjoining odd-mass nuclei with different spins, and (c) by comparing the average reduced widths for the various isotopes of uranium. It is concluded that S_J is proportional to $(2J + 1)^{-1}$, and therefore that the optical potential should have a contribution which is dependent on target spin. (auth)

16478 COULOMB FIELD EFFECTS IN BREMSSTRAHLUNG PROCESSES ASSOCIATED WITH β-DECAY. R. Vinh-Mau (CERN, Geneva). Nuovo cimento (10), 19: 609-11(Feb. 1, 1961). (In English)

Effects of nuclear Coulomb fields on internal bremsstrahlung following β-decay are studied. Methods are given for describing the relativistic Coulomb effects in both intermediate and final electron states, and for evaluating radial integrals. The results of the investigation are applied to S^{35} β-decay. The calculated γ-spectrum per β-decay, the γ circular polarization, and the β-γ angular correlation are compared with experimental data. (T.F.H.)

16479 ANNIHILATION OF POSITRONS IN LiH. A. T. Stewart and R. H. March (Dalhousie Univ., Halifax, Nova Scotia). Phys. Rev., 122: 75-6(Apr. 1, 1961).

The angular correlation of photons from positron annihilation in LiH and NaH was measured. The data yield a wave-function product density distribution much wider than the outer-shell electron density around the negative ion. This result is in contrast with the observations for other alkali halides for which these two distributions are much alike. (auth)

16480 MECHANISM OF THE REACTION $O^{16} + p \rightarrow p + 4\alpha$ AT 29 Mev. Oscar C. Kolar (Univ. of California, Berkeley). Phys. Rev., 122: 139-50(Apr. 1, 1961). (UCRL-3012(Rev.))

An expansion cloud chamber containing oxygen gas at $\frac{1}{3}$ atmosphere pressure was used to study the reaction $O^{16} + p \rightarrow p + 4\alpha$ at a bombarding energy of 28.9 Mev. Two hundred and twelve events were obtained that satisfied the criteria of energy and momentum balance. Ninety-one of these had all five outgoing prongs visible, while the remaining 121 had but four prongs visible, the fifth being obscured by the beam. Slightly more than half of all the events showed the presence of the ground state of Be^8. Of these, five events showed the presence of two Be^8 nuclei in the ground state. The events exhibiting the presence of a single ground-state Be^8 were interpreted according to the mechanism $O^{16} + p \rightarrow p + 2\alpha + Be^8$; $Be^8 \rightarrow 2\alpha$. The possibility of a compound state was considered. If such an intermediate state did occur, it was such that it did not obey strictly the predictions of the compound-nucleus theory. The remaining half of the events did not show evidence for any intermediate nuclei (with the possible exception of the appearance of the 1.4-Mev state of B^9 in 5%, or fewer, of the cases) and could be interpreted only on the basis of the direct quadripartition of the oxygen nucleus. (auth)

16481 ANALYSIS OF SOME DEUTERON-INDUCED REACTIONS IN OXYGEN-18. J. C. Armstrong and K. S. Quisenberry (Univ. of Pittsburgh). Phys. Rev., 122: 150-63(Apr. 1, 1961).

The reactions $O^{18}(d,t)O^{17}$, $O^{18}(d,d')O^{18*}$, and $O^{18}(d,p)O^{19}$ are studied using 15-Mev deuterons and magnetic analysis of reaction particles. Absolute cross sections are determined for all reactions studied and the Butler-Born approximation is used to extract reduced widths when possible. Angular distributions of triton groups corresponding to the ground, 0.871-, 3.846-, 4.555-, 5.083-, and 5.378-Mev states of O^{17} are obtained. An estimate of the configuration admixtures in the O^{18} ground state is made from analysis of the reduced widths and indicates the presence of a sizable (about 6%) $(1f_{\frac{5}{2}}^2)_0$ component. The experimentally determined admixtures are compared with several theoretical estimates. All O^{18} levels observed in the inelastic deuteron scattering have been previously reported—the known 5.01-Mev state is not observed. The angular distribution of inelastic deuterons corresponding to the 1.982-Mev state of O^{18} is obtained and comparison of the absolute cross section with theory provides an estimate of the O^{18} deformation. Proton groups from $O^{18}(d,p)O^{19}$ reactions are observed corresponding to O^{19} excitations of 0, 1.469, 3.164, 3.948, (4.123), (4.586), (4.706), (5.165), 5.45, 5.707, and 6.279 Mev, where assignment of the levels in parentheses to O^{19} is uncertain. The known 0.096-Mev state is not observed and the proton group corresponding to 5.45-Mev excitation contains contributions from at least two states. Angular distributions leading to the O^{19} ground, 1.469-, 3.164-, 3.948-, 5.707-, and 6.279-Mev states are obtained

and reduced widths extracted. The l_n values for these angular distributions are ambiguous except for the ground-state reaction ($l_n = 2$) and the 1.469-Mev state reaction ($l_n = 0$). Analysis of the data suggests that J^π (ground state) = $5/2^+$ and J^π (0.096-Mev state) = $3/2^+$. Using parameter values estimated from the O^{19} energy level spectrum or obtained from neighboring nuclei, a description of this nucleus in terms of the strong-coupling unified model agrees with the data. (auth)

16482 ANGULAR YIELD OF NEUTRONS FROM THE T(d,n)He^4 REACTION FOR 6- TO 11.5-Mev DEUTERONS. Murrey D. Goldberg and James M. Le Blanc (Univ. of California, Livermore). Phys. Rev., 122: 164-8(Apr. 1, 1961). (UCRL-6142)

The angular yield of monoenergetic neutrons from the T(d,n)He^4 reaction was measured with 6.2-, 7.9-, 9.1-, 10.2-, and 11.4-Mev deuterons. The neutrons were detected with a proton recoil telescope which provided discrimination against neutrons from the T(d,np)T breakup reaction. The yield curves are all peaked forward, with a second maximum at about 65° which becomes more pronounced with increasing energy, and a back-angle rise. A quasi-absolute determination of the 0° cross section for this reaction is described. The measured yield curves are compared to those for the companion He^3(d,p)He^4 reaction and a strong similarity in shape and magnitude is noted. A simple stripping model is inadequate to describe these data. A distorted-wave calculation is required. (auth)

16483 14.4-Mev (n,2n) CROSS SECTIONS. L. A. Rayburn (Univ. of Georgia, Athens). Phys. Rev., 122: 168-71 (Apr. 1, 1961).

Cross sections for the (n,2n) reaction were measured at an incident neutron energy of 14.4 ± 0.3 Mev for 27 nuclides. These measurements were made relative to the cross section for the Cu^{63}(n,2n)Cu^{62} reaction. The relative cross sections were then converted to absolute cross sections by using the weighted mean of several Cu^{63}(n,2n)Cu^{62} reaction-cross-section measurements made by other investigators. (auth)

16484 SMALL-ORDER SHAPE FACTORS IN In^{114}, P^{32}, AND Y^{90}. R. T. Nichols, R. E. McAdams, and E. N. Jensen (Ames Lab., Ames, Iowa). Phys. Rev., 122: 172-81(Apr. 1, 1961). (IS-204)

The beta spectra of In^{114}, P^{32}, and Y^{90} were studied closely in an intermediate-image beta-ray spectrometer and compared to theoretical predictions in terms of a linear shape factor of the form (1 + aW). The values obtained for a were $(+0.0036 \pm 0.0021)/mc^2$ for In^{114}, $(-0.0133 \pm 0.0011)/mc^2$ for P^{32}, and $(-0.0047 \pm 0.0008)/mc^2$ for Y^{90}, all for electron kinetic energies from about 200 kev up to near the maximum beta energies. Tests were made to give indications for spectrometer fidelity. Because of the linearity of the shape-factor plots and the similarity in energy range, the comparative results from In^{114}, P^{32}, and Y^{90} are taken as a definite indication that for at least two of these activities the shape factors have nonzero slopes, irrespective of questions of instrumental fidelity. (auth)

16485 AVERAGE RADIATIVE CAPTURE CROSS SECTIONS FOR 7- TO 170-kev NEUTRONS. J. H. Gibbons, R. L. Macklin, P. D. Miller, and J. H. Neiler (Oak Ridge National Lab., Tenn.). Phys. Rev., 122: 182-201(Apr. 1, 1961).

Measurements of neutron radiative capture cross sections in the kev region were made using fast (millimicrosecond) time-of-flight techniques and a large liquid scintillator tank. Two series of measurements were completed on a number of nuclides. These are determinations of (1) cross sections relative to that of indium at 30 kev and at 65 kev for 49 elements, and (2) cross sections as a function of neutron energy for the following nuclei: Br, Nb, Pd, Ag, Cd, In, Sb, I, Pr, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Ta, W, Pt, and Au. Curve fits, using the statistical model, were obtained for Br, Nb, Ag, In, Sb, I, Pr, Tb, Ho, Tm, Lu, Ta, and Au. The results demonstrate the presence of the 2p giant resonance near A = 100 predicted by the optical model. The average nuclear parameters obtained are in good agreement with recent low-energy total cross-section results, but are in poor agreement with earlier results. Possible reasons for these disagreements are discussed. (auth)

16486 SPIN-ORBIT SPLITTING IN NUCLEI DUE TO TENSOR INTERACTION. Paul Goldhammer (Univ. of Nebraska, Lincoln). Phys. Rev., 122: 207-11(Apr. 1, 1961).

The effect of the tensor force in nuclei with closed shells plus one nucleon was investigated using second-order perturbation theory. It is found that one can explicitly exhibit the spin-orbit splitting due to the tensor force using some simple identities. The spin-orbit splitting in He^5 is computed, and found to be 3.4 Mev compared with an experimental value of 2.6 Mev. (auth)

16487 STATISTICAL THEORY OF GAMMA-RAY SPECTRA FOLLOWING NUCLEAR REACTIONS. E. S. Troubetzkoy (Nuclear Development Corp. of America, White Plains, N. Y.). Phys. Rev., 122: 212-17(Apr. 1, 1961).

A theory predicting γ-ray spectra following intermediate or high-energy nuclear reactions is derived on the basis of the statistical theory. The equations take a particularly simple form if the assumption is made that all radiative transitions are of the electric dipole type. The theory is applied to two specific reactions: inelastic neutron scattering and thermal neutron capture. Numerical calculations of spectra arising from thermal neutron capture by two gadolinium isotopes are shown to compare well with experiments. (auth)

16488 SOME CONSIDERATIONS CONCERNING THE NUCLEAR MATRIX ELEMENT IN BETA DECAY. Don S. Harmer (Georgia Inst. of Tech., Atlanta) and Morris L. Perlman. Phys. Rev., 122: 218-23(Apr. 1, 1961).

Evidence that the nuclear matrix element $\Sigma|B_{ij}|^2$ contributes to first-forbidden transitions may be deduced from the electron-capture–positron-emission ratios observed in these transitions and from an analysis of the energy and Z dependence of the coefficients of all the nuclear matrix elements involved. The analysis of these coefficients for the capture and for the emission processes shows that it is reasonable to expect that, except for $\Sigma|B_{ij}|^2$, these transitions would be characterized by essentially the same capture–positron ratios as those characteristic of allowed transitions. Consequently the deviations of the observed ratios from the allowed values would be due to contributions from $\Sigma|B_{ij}|^2$; and the magnitude of the deviation, in a particular case, together with lifetime information may be used to compute values for this matrix element and for the sum of the others. Values are thus computed from available experimental data for three $2- \rightarrow 2+$ transitions, and these are compared with values derived directly from theory of Rose and Osborne. In each case the value of $\Sigma|B_{ij}|^2$ computed from experiment is nearly as large as the theoretical $\Sigma|B_{ij}|^2$ value calculated for nucleon spin change two and is considerably larger than those calculated for spin change zero or one; furthermore, the "observed" value for the sum of the other matrix elements is considerably

smaller than the largest single matrix element calculated for spin change zero or one. These results are consistent with the conclusion that the nuclear states involved are of such a nature that the transitions proceed unhindered only via $\Sigma|B_{ij}|^2\Delta j = 2$. One arrives at the same conclusion on the basis of the shell model description of these nuclear states. For $2- \rightarrow 0+$ transitions, which can be effected only by $\Sigma|B_{ij}|^2$, the "observed" and theoretical values of the matrix element are in good agreement; and it is of interest to note that both the theoretical and "observed" values of $\Sigma|B_{ij}|^2$ in each of these $2- \rightarrow 0+$ transitions are about the same or smaller than the values for the $2- \rightarrow 2+$ transition in the same nucleus. (auth)

16489 CLUSTER NATURE OF Li^7 AND Be^7. T. A. Tombrello and G. C. Phillips (Rice Univ., Houston, Tex.). Phys. Rev., 122: 224-8(Apr. 1, 1961).

Measurements of the capture γ-radiation processes, mass $3 + \alpha \rightarrow$ mass $7 + \gamma$ and nucleon + $Li^6 \rightarrow$ mass $7 + \gamma$, give information about the cluster structure of the mirror nuclei Li^7 and Be^7. The cluster model predicts that the ground state and low excited states of these nuclei should have large reduced widths θ_{3+4}^2 for the configuration mass $3 + \alpha$ particle and small reduced widths θ_{1+6}^2 for the configuration nucleon + Li^6. Scattering experiments provide accurate initial, capturing, wave functions, and an assumption of the cluster nature of the final, bound, states allows the electromagnetic capture cross sections to be calculated and compared to experiment. The reduced widths deduced show that θ_{3+4}^2 is large, θ_{1+6}^2 is small, and that the ground states and first excited states of Li^7 and Be^7 are primarily of the two-body cluster form mass $3 + \alpha$ particle. (auth)

16490 DECAY OF 49-min Cd^{118} AND 5.1-sec In^{118}. Chester E. Gleit and Charles D. Coryell (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 122: 229-31 (Apr. 1, 1961).

The decay properties of 49-min Cd^{118} and its daughter 5.1-sec In^{118} are established. The Cd^{118} has a low β-decay energy and seems to be an allowed transition. The In^{118} has (4.2 ± 0.4)-Mev β-decay energy, with about 15% of the decays going to the 1.22-Mev excited state of Sn^{118}, both β transitions being allowed. It is proposed that a previously identified 4.5-min In species is a high-spin isomer In^{118m} not formed in the β decay of Cd^{118} or formed directly in uranium fission. (auth)

16491 ELASTIC SCATTERING OF ALPHA PARTICLES BY N^{15}. H. Smotrich, K. W. Jones, L. C. McDermott, and R. E. Benenson (Columbia Univ., New York). Phys. Rev., 122: 232-41(Apr. 1, 1961).

Absolute differential cross sections for the elastic scattering of alpha particles by N^{15} were measured in a differentially-pumped gas scattering chamber. The measurements were made at center-of-mass angles of 169.1, 149.5, 140.8, 125.3, 90.0, and 70.0 degrees for alpha-particle energies from 1.75 to 5.50 Mev, corresponding to 5.37- to 8.33-Mev excitation of the compound nucleus F^{19}. The experimental widths of the levels observed below approximately 3.5-Mev bombarding energy are generally narrow, in most cases less than 10 kev. Above 3.5 Mev a marked increase in the level width was observed. As a result of an analysis based on the Wigner-Eisenbud reaction theory, values of J, π, E_λ, and γ_{λ^2} were assigned to 16 levels in F^{19}. (auth)

16492 π^- SCATTERING FROM COMPLEX NUCLEI. R. M. Edelstein, W. F. Baker, and J. Rainwater (Columbia Univ., New York). Phys. Rev., 122: 252-61(Apr. 1, 1961). (NEVIS-88; CU-190; R-259)

Differential cross sections were measured for π^--carbon scattering at 69.5 and 87.5 Mev and π^--oxygen scattering at 87.5 Mev from 20° to 125° extending the technique of Baker, Rainwater, and Williams. The energy resolution was sufficient to measure pure elastic as well as 5- and 10-Mev inelastic cross sections. The modified Kisslinger optical-model equation was used to fit the elastic-cross-section data. A χ^2 analysis for the 69.5-Mev carbon data gave a nuclear radius parameter $r_0 = 1.05 \pm 0.02$ fermis and a fall-off parameter $t = 1.16 \pm 0.07$ fermis. These parameters give good fits to the other data as well. An energy dependence in the strength parameters for carbon is observed in qualitative agreement with prediction. (auth)

16493 STARS PRODUCED BY π^- CAPTURE IN A HYDROGEN BUBBLE CHAMBER CONTAINING DISSOLVED HELIUM. Michel Schiff (Univ. of Chicago), Roger H. Hildebrand, and Clayton Giese. Phys. Rev., 122: 265-6 (Apr. 1, 1961).

One-pronged stars produced by π^- capture in a hydrogen bubble chamber containing dissolved helium were investigated. The distribution of prong lengths in the interval 0.029 to 0.64 g/cm^2 is presented. About one-third of the prongs in this interval are found to have a unique range corresponding to tritons from the reaction $\pi^- + He^4 \rightarrow H^3 + n$. Some prongs lying beyond the triton peak are identified as protons from the reaction $\pi^- + He^4 \rightarrow H' + 3n$. The fraction of pions producing stars is found to be approximately equal to the helium concentration. (auth)

16494 K^--MESON SCATTERING IN NUCLEAR EMULSION. R. D. Hill, J. H. Hetherington, and D. G. Ravenhall (Univ. of Illinois, Urbana). Phys. Rev., 122: 267-72 (Apr. 1, 1961).

Elastic single scatterings of K^- mesons by nuclei of a dilute G5 photographic emulsion were experimentally measured for energies between 30 and 80 Mev. Accurate numerical calculations of the differential scattering cross sections were carried out by solving a Klein-Gordon wave equation for an optical-model potential of the Woods-Saxon form. Experimental and theoretical results are in good agreement both on an absolute and on a relative-variation basis if the real part of the K^--nuclear potential is attractive. The connection with low-energy K^--nucleon scattering is discussed. (auth)

16495 PROTON-HYDROGEN SCATTERING SYSTEM. Marvin H. Mittleman (Univ. of California, Livermore). Phys. Rev., 122: 499-506(Apr. 15, 1961). (UCRL-5941).

The impact parameter treatment of the scattering of protons by hydrogen is derived and is shown to be valid for energies greater than a few electron volts. A novel treatment of the resultant equations is given which significantly modifies previously obtained results for inelastic scattering and charge-exchange scattering. (auth)

16496 IONIZATION PRODUCED BY ATOMIC COLLISIONS AT Kev ENERGIES. [PART] III. J. B. Bulman and A. Russek (Univ. of Connecticut, Storrs). Phys. Rev., 122: 506-11(Apr. 15, 1961).

The electron evaporation model of the collision-ionization process that occurs when atoms collide at high energies is extended to include atoms with from two to eight electrons in the outer shell. Application of the model to data from collisions of N^+ on Ar and Ne^+ on Ar gives evidence for a resonant electron capture effect taking place in high-energy violent collisions which was heretofore masked by the multiple ionization consequent on such collisions. (auth)

16497 CARBON-13 NEUTRON TOTAL CROSS SECTION. H. O. Cohn, J. K. Bair, and H. B. Willard (Oak Ridge National Lab., Tenn.). Phys. Rev., 122: 534-5 (Apr. 15, 1961).

The total neutron cross section of carbon-13 was measured for neutron energies from 110 kev to 9 Mev and from 16 Mev to 23 Mev. Four narrow resonances were observed as well as broad resonance structure above 3 Mev. The most probable spin assignments based on the resonance heights and widths are as follows: $E_R = 153 \pm 5$ kev, $\Gamma =$ 13 kev, $J = 1^+$; $E_R = 1751 \pm 8$ kev, $\Gamma = 20$ kev, $J = 1$; $E_R =$ 2432 ± 10 kev, $\Gamma = 17$ kev, $J = 2$; $E_R = 2454 \pm 10$ kev, $\Gamma =$ 10 kev, $J \geq 1$. (auth)

16498 GAMMA-GAMMA DIRECTIONAL CORRELATIONS IN Cs^{133}. Atam P. Arya (Pennsylvania State Univ., University Park). Phys. Rev., 122: 549-55(Apr. 15, 1961).

Directional correlation measurements were made on the 356 to 82 kev, 301 to 82 kev, and 80 to 82 kev gamma-gamma cascades in Cs^{133} following the decay of 8-year half-life Ba^{133} with a coincidence scintillation spectrometer using NaI detectors. The observed correlation functions are: $W(\theta) = 1 + (0.042 \pm 0.005)\ P_2(\cos\theta) - (0.0041 \pm 0.0038)\ P_4(\cos\theta)$, $W(\theta) = 1 - (0.0257 \pm 0.011)\ P_2(\cos\theta) - (0.0002 \pm 0.008)\ P_4(\cos\theta)$, and $W(\theta) = 1 + (0.0487 \pm 0.017)\ P_2(\cos\theta) + (0.0011 \pm 0.012)\ P_4(\cos\theta)$, respectively, for the three cascades. These gamma-gamma directional correlations were found to be consistent with spin assignments of $7/2^+$, $5/2^+$, $3/2^+$, $3/2^+$, and $1/2^+$ to the levels at the ground state, 82-kev, 162-kev, 383-kev, and 438-kev in Cs^{133}. The probable assignment of the multipolarities for different gamma rays is as follows: The 356-kev gamma ray is pure E2. The 82-kev gamma ray is a mixture of (96.5 ± 0.5)% M1 and (3.5 ± 0.5)% E2 with $\delta_{82} = -0.190 \pm 0.014$. The 301-kev gamma ray can have one of two possible mixtures: either $\delta_{301} = +0.123 \pm 0.004$ with a mixture of (98.5 ± 1.0)% M1 and (1.5 ± 1.0)% E2, or $\delta_{301} = -3.98 \pm 1.02$ with a mixture of (6 ± 2)% M1 and (94 ± 2)% E2. The value of $\delta_{301} = -3.98 \pm 1.02$ is more probable. The 80-kev gamma ray is also found to have two possible values of δ_{80}: either $\delta_{80} = +0.47 \pm 0.09$ with a mixture of (82 ± 6)% M1 and (18 ± 6)% E2, or $\delta_{80} = +7.0$ with a mixture of (2.0 ± 1.5)% M1 and (98.0 ± 1.5)% E2. (auth)

16499 DECAY OF K^{42} AND Sc^{44}. John D. McCullen and J. J. Kraushaar (Univ. of Colorado, Boulder). Phys. Rev., 122: 555-65(Apr. 15, 1961).

The low excited states of Ca^{42} and Ca^{44} were studied in the decay of K^{42} and Sc^{44}, with special emphasis on the observation of weakly populated states. In the K^{42} decay, gamma rays were seen at 0.31 Mev (1.1%), 0.49 Mev (<0.1%), 0.60 Mev (0.1%), 0.90 Mev (0.1%), 1.02 Mev (0.1%), 1.52 Mev (100%), 1.92 Mev (0.3%), and 2.42 Mev (0.2%). The coincidence sequence of the transitions were measured and a level scheme constructed. In the Sc^{44} decay, gamma rays were seen with energies and intensities of 0.68 Mev (3.2%), 1.02 Mev (3.1%), 1.12 Mev (4.7%), 1.16 Mev (100%), 1.50 Mev (1.7%), 1.72 Mev (0.8%), 2.28 Mev (0.2%), and 2.69 Mev (0.2%). Coincidence measurements were also taken for this isotope to clarify the cascade sequences, and a level scheme was constructed. A search was made for low-energy conversion electrons (E<1 Mev) in an effort to establish the existence or nonexistence of a low-lying 0^+ state in Ca^{44}, whose analog occurs as the second excited 1.84-Mev state in Ca^{42}. No such conversion electrons were seen, by either electron spectrometer studies or by electron-delayed gamma-ray coincidence measurements. An upper limit of 0.05% of the total decay of Sc^{44} was put on the population of such a state. (auth)

16500 INELASTIC SCATTERING OF DEUTERONS FROM THE MAGNESIUM ISOTOPES. A. G. Blair and E. W. Hamburger (Univ. of Pittsburgh). Phys. Rev., 122: 566-71(Apr. 15, 1961).

Natural and enriched magnesium targets were bombarded with 15-Mev deuterons from the University of Pittsburgh cyclotron. The reaction products were magnetically analyzed and detected by a scintillator or by nuclear emulsions. Angular distributions were obtained for the deuterons inelastically scattered from the Mg^{24} 1.37-, Mg^{25} 1.61-, and Mg^{26} 1.83-Mev states. The results are compared to the predictions of the plane-wave Born approximation theory and of the inelastic diffraction scattering model. The curves obtained from the Born approximation give better over-all correspondence with the experimental points. The inelastic diffraction scattering model, however, allows one to extract directly the effective values of the nuclear deformation parameter β. One obtains $|\beta| = 0.20$, 0.19, and 0.17 for Mg^{24}, Mg^{25}, and Mg^{26}, respectively. The spectra of deuterons inelastically scattered from Mg^{25} and Mg^{26} were also observed, at $\theta_{lab} \approx 12°$, 30°, and 60°. The only large cross sections in Mg^{25} were those for the 1.61-Mev ($1/2^+$) level and for a level near 3.4 Mev. The strength of the reaction to the latter level suggests that it is the $9/2^+$ member of the ground-state rotational band which, in analogy with Al^{25}, should appear at approximately this energy. The results tend to confirm the selection rule that favors collective excitations over single-particle excitation in inelastic scattering. In Mg^{26} strong scattering was observed only from the first two excited states. A previously unreported Mg^{26} state was found at the excitation energy of 3.614 ± 0.020 Mev. (auth)

16501 TWO-NUCLEON INTERACTION FROM DOUBLET SPLITTINGS. F. C. Barker (Australian National Univ., Canberra). Phys. Rev., 122: 572-7(Apr. 15, 1961).

The splitting of closely spaced doublet levels, of spin $J + 1/2$ and $J - 1/2$, is investigated in cases which can be approximated by a core of spin J and an s nucleon. Allowance is made for the Thomas shifts of the levels. Using j-j coupling wave functions, the exchange parameters and strength of the effective interaction between nucleons in the nucleus are determined by a least-squares fit to the doublet splittings and give some improvement over results obtained with previously accepted parameters. It is suggested that measurement of the sign of some doublet splittings would clarify the interaction further. (auth)

16502 SIMPLE REALISTIC TREATMENT OF NUCLEAR DIRECT-INTERACTION PROCESSES. Ian E. McCarthy and Derek L. Pursey (Univ. of California, Los Angeles). Phys. Rev., 122: 578-90(Apr. 15, 1961).

Physical arguments are used to predict qualitatively the effect on direct-interaction differential cross sections of the distortion of the wave functions of the scattered particle. These qualitative predictions are confirmed by calculations using a simple but fairly realistic model for the wave function distortion in (α,α') scattering. The model used is based on examination of the properties of optical model wave functions. Good fits to experimental data are found using the model for (α,α') scattering in the energy range 20 to 40 Mev for scattering angles less than 90°. Features of direct-interaction processes involving nucleons are interpreted in terms of a focus in the optical model wave functions for these particles, but detailed calculations are not presented. (auth)

16503 NUCLEAR SPIN OF Ho^{166}. W. J. Childs and L. S. Goodman (Argonne National Lab., Ill.). Phys. Rev., 122: 591-4(Apr. 15, 1961).

The hyperfine structure of Ho^{166} was examined by means of the atomic-beam magnetic-resonance technique. The atomic ground state appears to be $^4I_{15/2}$, and g_J has the measured value 1.19509 ± 0.00007, in close agreement with the

Russell-Saunders value of 6/5. Only one resonance is observed, and its transition frequency for $0.15 \leq H \leq 150$ gauss is proportional to the magnetic field strength to within experimental error. The simplest interpretation is that the nuclear spin is I = 0. It is shown that if I = 1, the magnetic hyperfine interaction constant a must be less than 5 kc/sec. (auth)

16504 (p,d) PICKUP REACTIONS IN LIGHT NUCLEI. E. F. Bennett (Princeton Univ., N. J.). Phys. Rev., 122: 595-606(Apr. 15, 1961). (PUC-1960-13).

Using a thin proportional counter as a velocity selector in conjunction with a NaI crystal to measure energy, deuterons from proton-induced reactions in some light nuclei were studied. The detection system was capable of presenting an essentially undistorted spectrum of deuterons in the presence of protons of the same energy and considerably more intense. Angular distributions of deuterons from $C^{13}(p,d)C^{12}$, $N^{14}(p,d)N^{13}$, $N^{15}(p,d)N^{14}$, $F^{19}(p,d)F^{18}$, $Mg^{25}(p,d)Mg^{24}$, and $P^{31}(p,d)P^{30}$ were taken. Butler curves were calculated to fit the experimental distributions and level widths extracted. (auth)

16505 ELASTIC SCATTERING AND REACTIONS OF PROTONS ON O^{18}. R. R. Carlson, G. C. Kim, J. A. Jacobs, and A. C. L. Barnard (State Univ. of Iowa, Iowa City). Phys. Rev., 122: 607-16(Apr. 15, 1961).

The elastic scattering of $O^{18}(p,p)O^{18}$ and the reactions $O^{18}(p,p'\gamma)O^{18}$, and $O^{18}(p,\alpha_{1,2}\gamma_{1,2})N^{15}$ were studied using a thin gas target with electrostatic generator. Absolute differential cross sections were measured for the two laboratory angles 86.8° and 159.5° in the incident proton energy range 790 to 3550 kev and angular distributions for α_0 and p were measured at several energies. Relative yield curves of gamma rays were obtained in the same energy range as above. Two F^{19} levels were observed which were not previously reported and some new decay modes for previously known levels were observed. From consideration of the detailed shape of the elastic-scattering anomalies and the angular distributions, spin and parity assignments were made to some F^{19} levels. (auth)

16506 ELASTIC SCATTERING OF NEGATIVE PIONS BY PROTONS AT 230, 290, 370, AND 427 Mev. Lester K. Goodwin, Robert W. Kenney, and Victor Perez-Mendez (Univ. of California, Berkeley). Phys. Rev., 122: 655-64 (Apr. 15, 1961). (UCRL-9119-R).

The elastic differential cross section for the scattering of negative pions by hydrogen was measured at laboratory-system pion kinetic energies of 230, 290, 370, and 427 Mev. The elastically scattered pions were detected by a counter telescope which discriminated against recoil protons and inelastic pions on the basis of range. Differential cross sections were obtained at nine angles for each energy and were fitted by a least-squares program to a series of Legendre polynomials. At the three higher energies, D waves are required to give satisfactory fits to the data. The real parts of the forward-scattering amplitudes calculated from this experiment are in agreement with the predictions of dispersion theory. The results of this experiment, in conjunction with data from other pion-nucleon scattering experiments, support the hypothesis of charge independence at these higher energies. (auth)

16507 PHENOMENOLOGICAL STUDY OF PION PHOTOPRODUCTION WITH POLARIZED PROTONS. G. T. Hoff (Univ. of Chicago). Phys. Rev., 122: 665-9 (Apr. 15, 1961).

Expressions for the angular distributions and polarizations of pion photoproduction with polarized photon beams are derived from phenomenological production matrix. The experiments necessary for the complete determination of the multipole amplitudes are discussed in general, and in particular for the case in which only contributions up to p waves in the final state are important. Complete determination requires circularly polarized beams. But if only s and p waves contribute, experiments with linearly polarized beams completely determine the production matrix. The knowledge of these amplitudes would allow the determination of the unknown p-wave scattering phase shifts (α_{11}, α_{13}, and α_{31}) up to energies of about 300 Mev. Invariance properties of the angular distributions and polarizations are found and tables are given. (auth)

16508 RANGE OF PROTON-ANTIPROTON ANNIHILATION NEAR 1.0 Bev. Osamu Hara (Univ. of Minnesota, Minneapolis). Phys. Rev., 122: 669-71(Apr. 15, 1961).

The range of the proton-antiproton annihilation was calculated for antiproton with energy near 1 Bev. The point is to get the range of pure annihiliation interaction, separating the effect of pion production. It was found that the root mean square of this range is given by $(1.19 \pm 0.07) \times 10^{-13}$ cm almost independently of the energy. (auth)

16509 NUCLEAR INTERACTIONS AND MEAN FREE PATHS OF PROTONS, NEUTRONS, AND ALPHA PARTICLES AT ENERGIES AROUND 250 Bev NUCLEON. E. Lohrmann, M. W. Teucher, and Marcel Schein (Univ. of Chicago). Phys. Rev., 122: 672-86(Apr. 15, 1961).

Nuclear interactions of protons, neutrons, α particles, and heavier nuclei of average energy 250 Bev/nuc were studied in nuclear emulsion. The source of these particles was fragmentations of heavy primary nuclei of the cosmic radiation. Their energy was determined from multiple scattering measurements. The interaction mean free path for protons is 41 ± 10 cm, for α particles 27 ± 7 cm. The mean free path shows no significant change compared with measurements at lower energies. The mean number of shower particles (n_s) depends appreciably on the mass of the target nucleus. Our best estimate for nucleon-nucleon collisions at 250 Bev is $(n_s) = 8.8 \pm 1.9$. A detailed comparison of the estimate of the primary energy obtained from the angular distribution of shower particles with the true primary energy is carried out. The angular distribution of the shower particles will, in an individual case, give a quite unreliable value for the primary energy. In the average, the angular distribution method will overestimate the true primary energy by a factor of 1.3 for interactions with a number of heavy prongs $N_h \leq 5$. If $N_h > 5$, the angular distribution will underestimate the true energy in the average by a factor of 1.8. The angular distributions can be transformed into a system in which they are symmetric. This is even true for collisions with heavy target nuclei ($N_h > 5$). The results for alpha particle and heavy nucleus collisions are quite similar. The inelasticity for the proton and neutron interactions shows large fluctuations for individual events. It depends weakly on the number of shower particles and on the mass of the target nucleus. Its mean is 50%. The mean value for the alpha-particle collisions is 22%. (auth)

16510 ORIGIN OF THE F^{19} HYPERFINE STRUCTURE IN TRANSITION ELEMENT FLUORIDES. A. J. Freeman (Ordnance Materials Research Office, Watertown, Mass.) and R. E. Watson. Phys. Rev. Letters, 6: 343-5(Apr. 1, 1961).

The F^{19} hyperfine structure (hfs) in fluorides of transition metals (Mn, Fe, etc.) is examined. Several models are described to explain the observed unpairing. This unpairing

supposedly arises either from an admixture of covalent bonding into the pure ionic state, or from the Pauli principle by which F^- orbitals are affected in 2 ways, for F^- orbital spin the same as or opposite to the 3d cation spin. The results of including 1s unpairing actions and terms including the magnitude of the cation 3d wave function evaluated at the F^- nucleus are investigated for both models discussed. (T.F.H.)

16511 DIRECTION OF INTERNAL MAGNETIC FIELDS IN RARE EARTH IONS. M. E. Caspari, S. Frankel, D. Ray, and G. T. Wood (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Letters, 6: 345-6(Apr. 1, 1961).

The signs of magnetic fields acting at the nuclei of rare earth ions in rare earth-iron garnets are reported. The rotations of the γ angular correlation patterns obtained in $2^+ \rightarrow 0^+$ transitions in Sm^{152}, Gd^{154}, and Dy^{160} are observed. It is assumed that the direction of magnetization is determined by the Fe sublattice spins ($\vec{S}_{Fe}$), that the orientation of the orbital angular momentum ($\vec{L}$) and the spin ($\vec{S}$) is given by Hund's rule, and that the spins of the rare earth ions are antiferromagnetically oriented with respect to $\vec{S}_{Fe}$. (T.F.H.)

16512 PROTON SPECTRA FROM D(n,p)2n REACTION AT 14.4 MEV. K. Ilakovac, L. G. Kuo, M. Petravic, I. Slaus, and P. Tomas (Institute "Ruder Boskovic," Zagreb). Phys. Rev. Letters, 6: 356-8(Apr. 1, 1961).

The protons from the reaction D(n,p)2n are studied for an incident neutron energy of 14.4 Mev, in order to determine the existence of a final state n-n interaction. A deuterated paraffin target is used, and scattering angles of 0 and 10° are studied. No conclusions concerning the existence of a bound dineutron are drawn. (T.F.H.)

16513 RADII OF OPTICAL-MODEL POTENTIALS IN PROTON SCATTERING AT 183 MEV. P. E. Hodgson (Clarendon Lab., Oxford). Phys. Rev. Letters, 6: 358-60 (Apr. 1, 1961).

Proton scattering by Li, Be, C, Al, Fe, Ca, Ir, and Au is studied, using an optical model for the scattering nucleus. The optical model parameters involved in 183 Mev proton scattering by Al are adjusted to fit the observed differential scattering cross section vs. lab scattering angle relations. These adjusted parameters give qualitative agreement between calculated and observed scattering for the other nuclei under consideration. (T.F.H.)

16514 NUCLEAR ORIENTATION OF PARAMAGNETIC IMPURITY IONS. Morton Kaplan and D. A. Shirley (Univ. of California, Berkeley). Phys. Rev. Letters, 6: 361-2 (Apr. 1, 1961). (UCRL-9569)

The ions are incorporated as impurities in cerium magnesium nitrate (CMN) and cooled by adiabatic demagnetization. The ions may be polarized by several hundred gauss at <0.01°K. The method is described for Cr^{51} at ~0.003°K and 200 and 400 gauss, in a single crystal of CMN. The orientation is measured from the anisotropy of the 325 kev γ rays at 0 and 90° to the magnetic field. Further investigations yield values for the E2-M1 mixing ratio of V^{51}, for spin assignments, and for magnetic moments of Cr^{51}. (T.F.H.)

16515 SCATTERING CROSS SECTIONS OF GAMMA RADIATION. V. Lakshminarayana and S. Jnanananda (Andhra Univ., Waltair, India). Proc. Phys. Soc. (London), 77: 593-8(Mar. 1, 1961).

Total cross sections of gamma rays from Co^{60}, Sc^{46}, Cs^{137}, Cr^{51}, and Ce^{141} are determined in graphite, Al, and Cu, using a scintillation spectrometer of modified narrow beam geometry. The values of total scattering cross section (σ) are obtained by subtracting the theoretical values of photoelectric and pair cross sections from the total experimental values. For energies greater than 320 kev good agreement is observed between theoretical and experimental values of σ, while at the energy 145 kev definite deviations are observed. The deviations are ascribed to the overestimation of σ by the use of atomic charge distribution predicted by the Thomas-Fermi model. (auth)

16516 THE LIFETIME OF THE 364 Kev LEVEL IN Xe^{131}. W. D. Hamilton (Univ. of Birmingham, Eng.). Proc. Phys. Soc. (London), 77: 610-16(Mar. 1, 1961).

The nuclear resonant scattering technique for γ rays is used to measure the lifetime of the 364 kev level in Xe^{131}, and to determine the mixing ratio of the E2 ± M1 ground state transition. The measured lifetime of $(1.4 \pm 0.4) \times 10^{-11}$ sec is in agreement with the estimated value of 2×10^{-11} sec. A 0.34% M1 admixture is found for the 364 kev transition, and is of the order expected from internal conversion coefficient measurements. (auth)

16517 ELECTRON COLLISIONS WITH Na ATOMS. A. Salmona (Inst. Henri Poincaré, Paris) and M. J. Seaton. Proc. Phys. Soc. (London), 77: 617-29(Mar. 1, 1961).

Results of calculations for energies above the 3p excitation threshold and also for the limit of zero kinetic energy, (K = 0) are given. For the higher energies the Bethe approximation is used to calculate partial wave integrals and the transmission matrix is then obtained by two different conservation-preserving methods. The only potential considered is V(3s,3p). For energies not too close to the 3p threshold these calculations give good results for the 3s–3p cross section and fairly good results for the total cross section. This shows that a substantial part of the elastic scattering is due to the process 3s→3p→3s. At very low energies exchange effects and polarization effects are both large and a much more elaborate theory is required. The coupled integro-differential equations, of Hartree–Fock type, are discussed. It is shown that the coupling between 3s and 3p accounts for 99.4% of the atom polarizability. Solutions of the coupled equations for 3s and 3p are obtained for the case of K = 0. The calculated zero-energy elastic cross section is $380\pi a_0^2$ and the exchange cross section is $440\pi a_0^2$. (auth)

16518 FLUORESCENCE AND OTHER YIELDS OF THE L_{II} SHELL IN Pu. L. Salgueiro, J. G. Ferreira, J. J. H. Park, and M. A. S. Ross (Edinburgh Univ.). Proc. Phys. Soc. (London), 77: 657-64(Mar. 1, 1961).

A study is made of the L x-rays emitted after the disintegration of Cm^{242} to determine the fluorescence and other yields of the L_{II} sub-shell in Pu. Observations are made on the total intensity per disintegration by observing the L x-rays in coincidence with α-particles from Cm^{242}, and on the relative intensity of the L x-rays from the L_{II} and L_{III} sub-shells. The experimental results are: fluorescence yield $\omega_2 = 0.413 \pm 0.02$, Coster–Krönig yield $f_{23} = 0.22 \pm 0.08$, and Auger yield $a_2 = 0.37 \pm 0.08$. The total fluorescence yield of the L shells is $\bar{\omega} = 0.486 \pm 0.01$. For the distribution of yields between f_{23} and a_2 it is necessary to use an extrapolated value of ω_3. (auth)

16519 A LEVEL CROSSING EXPERIMENT IN MERCURY. J. N. Dodd (Univ. of Otago, Dunedin, New Zealand). Proc. Phys. Soc. (London), 77: 669-72(Mar. 1, 1961).

A change in the resonance fluorescence intensity may take place when Zeeman states of 2 excited levels have the same energy. The fields at which these level crossings occur in Hg^{199} and Hg^{201} are measured. Combined with determinations of the hyperfine coupling constants, the re-

lts yield, for the $^3P_1$ states, $g_J(Hg^{199}) = 1.48634 \pm 0.00005$, d $g_J(Hg^{201}) = 1.48606 \pm 0.00015$. (auth)

6520 THE $Ni^{58}(d,p)Ni^{59}$ AND $Ni^{60}(d,p)Ni^{61}$ REACTIONS. . W. Dalton, G. Parry, H. D. Scott, and S. Swierszczewski Jniv. of Liverpool). Proc. Phys. Soc. (London), 77: 682-90 Mar. 1, 1961).

Targets of natural Ni and isotopically pure Ni^{60} are bombarded by deuterons with energies of 8.9 and 8.6 Mev respectively. From the resulting proton energy spectra a umber of angular distribution measurements are made for he $Ni^{58}(d,p)Ni^{59}$ and $Ni^{60}(d,p)Ni^{61}$ reactions, and spin and arity assignments are made to states of Ni^{59} and Ni^{61}. auth)

6521 ELASTIC SCATTERING OF SLOW ELECTRONS BY HELIUM ATOMS. B. L. Moiseiwitsch (Univ. of Colorado, Boulder). Proc. Phys. Soc. (London), 77: 721-3 Mar. 1, 1961).

The scattering length for elastic collisions between electrons and He atoms is calculated, with full allowance for distortion and exchange, by the exact numerical integration of the appropriate integro-differential equation for the zero-order partial wave. The resulting cross section $26a_0^2$ for electrons of zero impact energy is in agreement with the available experimental data, so that the effect of polarization, which is neglected in the present calculation, is probably small. (auth)

16522 THE ELASTIC SCATTERING OF ELECTRONS AND POSITRONS BY HYDROGEN ATOMS. A. E. Kingston and B. G. Skinner (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 77: 724-8(Mar. 21, 1961).

The second Born approximation for the differential cross section, by including only terms to the third order in the interaction energy, is employed to calculate the differential and total cross sections for the elastic scattering of electrons and positrons by H atoms. Allowance is made for both distortion and polarization by evaluating the terms which correspond to transitions through the 1s, 2s and 2p intermediate states. It is found that for electrons with impact energies below 100 ev, distortion and polarization tend to increase the total cross section appreciably above the first Born cross section. For positrons, distortion and polarization decrease the total cross section. (auth)

16523 POSITRONIUM FORMATION IN HELIUM. H. S. W. Massey and A. H. Moussa (University Coll., London). Proc. Phys. Soc. (London), 77: 811-16(Mar. 1, 1961).

The positronium formation cross section in a positron collision with a normal He atom is calculated by Born's approximation for positron energies up to 125 ev. As judged by the size of the maximum cross sections obtained at positron energy of 27 ev, the coupling between elastic scattering and positronium formation is far from weak. This coupling suggests that virtual formation of positronium may play an important part in the elastic scattering of slow positrons by He atoms. The coupled equations for this effect are derived. (auth)

16524 HIGH ENERGY ELASTIC SCATTERING OF NUCLEON FROM NUCLEI. ANALYSES OF EXPERIMENTAL DATA. Toshinori Takemiya (Kyoto Univ.), Tatuya Sasakawa, and Yoshiyuki Sakamoto. Progr. Theoret. Phys. (Kyoto), 24: 1307-16(Dec. 1960). (In English)

The angular distributions of nucleons elastically scattered from nuclei are analyzed at energies ranging from 95 to 340 Mev. Predictions on the angular distribution are examined. All the predictions seem to be satisfied. (auth)

16525 EFFECT OF A REPULSIVE CENTER IN A STATISTICAL MODEL OF HEAVY NUCLEI. Victor Flores Maldonado (Universidad Nacional Autónoma, Mexico City). Rev. mex. fís., 9: 163-79(1960). (In Spanish)

Previously, the binding energies of heavy nuclei have been computed theoretically by using a statistical model and a Yukawa interaction. The values obtained were very high compared with the experimental values. The present work uses the same model but a repulsive core is added to the Yukawa interaction. It is found that the repulsive core reduces the binding energy to a large extent, greatly improving the values obtained earlier. Nevertheless, the present results are not satisfactory yet. Some ways that would improve these results are indicated. (auth)

Particle Accelerators

16526 (BNL-654) MEASUREMENT OF RANGE AND INTENSITY OF CYCLOTRON BEAMS. J. R. Grover, B. M. Foreman, Jr., B. D. Pate, C. P. Baker, and J. Hudis (Brookhaven National Lab., Upton, N. Y.). Sept. 1960. 5p.

An assembly of a Faraday cup, foil wheel, and target holder is described. Provision is made for the convenient measurement of the energy of cyclotron-accelerated ions by means of their range in aluminum and for determination both of instantaneous and of integrated beam intensity. This system is intended for use in the measurement of cross sections and excitation functions by the activation of metal foils or other thin targets. As a check on its operation, the maximum cross section for the reaction $Bi^{209}(\alpha,2n)At^{211}$ was measured and found to be 0.99 ± 0.04 barns at about 30.5 Mev, in agreement with previous determinations. (auth)

16527 (INS-TH-17) INJECTION METHOD FOR AN A. G. SYNCHROTRON USING BEHAVIORS OF BETATRON OSCILLATION NEAR RESONANCE-LINE. Yoshiyuki Kobayashi and Hiroshi Sasaki (Tokyo Univ. Inst. for Nuclear Study). Aug. 23, 1957. 27p.

An examination was made of an efficient injection method using the properties of betatron oscillation near a resonance line. Considerations are given for the solution of the equation of radial motion in an A. G. synchrotron. Discussions are given of the damping of the oscillations in a stopband and in a stable region near a resonance line. It is considered that damping in a stable region caused by a disturbing field is the most advantageous injection method, because the effects of a momentum error and an angular divergence of the beam are small. Appendixes include: discussions of the shift of stability diamond with one and two Q magnet, and of the arrangement of Q magnets for $4-\pi$ resonance, where the transformation matrix becomes the unit matrix; and a tabulation of the basic parameters of the 1-Bev electron synchrotron. (B.O.G.)

16528 (INS-TH-18) DYNAMIC MAGNETIC FIELD MEASUREMENTS WITH PEAKING-STRIPS. Seitaro Yamaguchi, Yoshiyuki Kobayashi, Hiroshi Sasaki, Ryuji Yamada (Tokyo Univ. Inst. For Nuclear Study). Sept. 19, 1957. 17p.

A study was made of the effects of the field rise rate on the pulse wave form generated by the reversal of saturation of flux in the peaking-strips, for the calibration of the peaking-strips. The information obtained from the study was applied to the data of magnetic field measurements on a synchrotron model magnet. The characteristics of peaking-strips in dynamic fields are discussed. (B.O.G.)

16529 (INS-TH-21) THE INFLUENCE OF MOMENTUM ERROR ON THE OPERATION POINT AND POLE-FACE SHAPING. Yoshiyuki Kobayashi and Hiroshi Sasaki (Tokyo Univ. Inst. for Nuclear Study). Aug. 23, 1957. 10p.

A general form of the equations of motion was used to

obtain the conditions that the betatron oscillation frequency be independent of the momentum of a particle moving in a stable orbit. Discussions are given of the field distribution required from these conditions, and the behavior of the operation point of such a particle on the stability pattern for an adequate pole-face shaping. Considerations are given for the influence of the pole-face shapings on the motion of a particle with momentum, p_0, on the central orbit. (B.O.G.)

16530 (INS-TH-22) EFFECTS OF ERRORS OF POLE-FACE SHAPE. Yoshiyuki Kobayashi (Tokyo Univ. Inst. for Nuclear Study). Sept. 10, 1957. 22p.

Considerations are given for a mathematical treatment of the effects of periodic errors of the pole-face shape, to determine the relation between the wavelength of error and the variation of the field distribution. The problem is simplified by assuming particular periodic errors, and calculating the field distribution approximately. The treatment is extended to aperiodic errors, expanding errors in polynomials, which are of use for errors of relatively simple form. A comparison is given of experimental results obtained for a half-scale model magnet with the theoretical results. (B.O.G.)

16531 (INS-TH-23) THE SERIES RESONANCE CIRCUIT FOR THE EXCITATION OF THE SYNCHROTRON MAGNET. Yoshiyuki Kobayashi (Tokyo Univ. Inst. for Nuclear Study). Aug. 23, 1957. 17p.

An examination was made of the properties of a series resonance circuit in order to avoid difficulties which occur in insulation problems, and in phase differences between the magnetic fields of unit magnets caused by stray capacitances of the coils. Procedures of construction are outlined which satisfy the requirements of the choke coils. It was concluded that the effects of stray capacitances may be minimized by making the potential at corresponding points in the circuit identical, and the inductance leakages may be minimized by using long yoke units. (B.O.G.)

16532 (INS-TH-26) SOME PROBLEMS OF THE POWER SUPPLY CIRCUIT FOR 1-BEV ELECTRON SYNCHROTRON. Yoshiyuki Kobayashi (Tokyo Univ. Inst. for Nuclear Study). Sept. 24, 1957. 14p.

Considerations are given for problems in designing a power supply circuit for the excitation of the synchrotron magnet. The problems concern the effect of the saturation of the magnet yoke, and the impedance seen from the a-c generator. (B.O.G.)

16533 (INS-TH-27) THE DESIGN OF THE MAGNET FOR INS (JAPAN) 1-BEV ELECTRON SYNCHROTRON. Hiroo Kumagai, Seitaro Yamaguchi, Yoshiyuki Kobayashi, Hiroshi Sasaki, and Ryuji Yamada (Tokyo Univ. Inst. for Nuclear Study). Sept. 24, 1957. 27p.

An outline is given of work completed in the design of a magnet for the 1-Bev electron synchrotron. Discussions are given of: measurements of the effective coercive forces of the sheet iron and cemented blocks of the yoke; the construction of the yoke and pole pieces; the design of the base for the magnet; the design of the coil; and the power supply. Parameters are tabulated for the magnet, resonance circuit, loss estimation, and the a-c generator. (B.O.G.)

16534 (MURA-596) THEORETICAL REMARKS CONCERNING THE $3\sigma_x + 2\sigma_y = 2\pi$ RESONANCE IN SPIRAL SECTOR ACCELERATORS. A. M. Sessler (Midwestern Universities Research Assn., Madison, Wis.). July 1957. Contract AT(11-1)-384. 8p.

Previously developed methods in which the equation for axial motion is treated as linear and the radial motion is independently prescribed are used to exhibit a resonance in a spiral sector accelerator in the neighborhood of $3\sigma_x$ $2\sigma_y = 2\pi$. Quantitative results are compared with computational results. (auth)

16535 (MURA-606) THE EFFECT OF NEARBY BUCKETS ON BUCKET AREA IN RF ACCELERATION. J. B. Boilen (Midwestern Universities Research Assn., Madison, Wis.). Feb. 14, 1961. Contract AT(11-1)-384. 4p.

Computer studies were made of rf acceleration in the presence of equal accelerating voltages at frequencies resonant with energies equally spaced above and below the synchronous energy. It is concluded that the accelerating bucket area is not significantly affected if the frequency spacing is such that $\Delta y \gtrsim 4$, but that for $\Delta y < 4$, the bucket area falls rapidly toward zero. ($\Delta y = [(2\pi h|df/dE|)/(fV)]^{1/2} \Delta E$.) (auth)

16536 COHERENT RADIATION OF ELECTRONS IN A 2.5 Mev CIRCULAR ACCELERATOR AT CENTIMETRE AND MILLIMETRE WAVELENGTHS. J. Datlov (Inst. of Vacuum Electronics, Academy of Sciences, Prague). Ceskoslov. časopis pro fysiku, No. 5, 395(1960).

The results of the classical theory relating to the radiation of the electrons which move along a circular path at velocities near to that of light are evaluated from the point of view of using this principle for the generation of the oscillations at wavelengths of the order of 1 mm. A description of miniature experimental synchrotrons having a maximum electron energy of 2.5 Mev is given. The theory was tested by means of this device. The results of the measurement of the radiated power at several harmonic frequencies in the waveband of 1-3 cm are shown. The limitation of this method is discussed and the possibility of increasing the radiated power at millimeter wavelengths is indicated. (auth)

16537 CZECHOSLOVAK BETATRON FOR 15 Mev AND ITS CHARACTERISTICS. K. Tytina (Inst. for Vacuum Electronics, Academy of Sciences, Prague). Ceskoslov. časopis pro fysiku, No. 5, 484(1960).

The constructional details of a betatron designed for industrial flaw detection are described. The technical parameters of the betatron and its principal characteristics are given. The application of the device and the results obtained by it are discussed. (auth)

16538 SOME PROBLEMS IN THE FOCUSING OF PARTICLES IN AN ACCELERATOR. J. Teichman (Inst. for Vacuum Electronics, Academy of Sciences, Prague). Ceskoslov. časopis pro fysiku, No. 5, 484(1960).

A theory of an accelerator with a generalized magnetostatic or adiabatically time-varying field was developed; it is assumed that the field is periodically dependent on the azimuth and that its components are defined on a generalized rotating plane. Such a field is general enough for various types of accelerators. The particle dynamics in the generalized field were analyzed and the dissipative forces due to the radiation were taken into account. The conditions for a single-parameter system of equivalent paths were derived, it being assumed that these are stable in the Lyapunov sense. It is shown that these conditions can be met in an accelerator with an azimuthally continuous field as well as in the sector-type accelerators. During the acceleration the position and the shape of the equivalent particles are usually changed. The rotation frequency of the particles is in general a function of energy. An optimum accelerator with an accurately constant rotation frequency and a stable betatron frequency is in general not physically realizable over the whole energy spectrum. Optimum accelerators can only be realized in the ultra-

ativistic energy region for a symmetrical field which creases exponentially along the axis of the accelerator. e conditions for the linear and nonlinear resonance were rived and the influence of the perturbation of the focusing nponents of the generalized field was investigated. (auth)

539 STRONG FOCUSING. M.-Y. Bernard. Nucleus aris), No. 1, 14p. (Jan.-Feb. 1960). (CEA-1556). (In ench)

A new step forward is made in the race toward high en- gies with the starting up of the CERN synchrotron. This paratus uses the principle of alternating focusing. The st problem of guiding a beam by showing the differences tween continuous and alternating focusing is considered. this latter method the use of divergent lenses makes it ssible to use very convergent devices (or very divergent), hereas with continuous focusing it is possible to use only nvergent devices which are necessarily "weakly" con- rgent. The principle of strongly converging synchrotrons d a description of several apparatuses using the alter- ting convergence principle (linear accelerators, mass ters, FFAG accelerators) are discussed. (auth)

540 MAGNET DESIGN OF A 29 Mev MICROTRON. R. Davies, R. E. Jennings, F. Porreca, and R. E. Rand niversity Coll., London). Nuovo cimento (10), 17: Suppl. o. 2, 202-10(1960). (In English)

The design of a magnet for a microtron to accelerate ectrons to an energy of at least 25 Mev (frequency of r.f. pply 300 MHz) is given, as well as details of the power pply to energize the magnet. The precession of the orbits ue to non-uniformity of the field is discussed and field easurements, made before and after shimming, are given. uth)

6541 TWO DIFFUSION CHAMBERS FOR EXPERI- IENTS WITH THE 1100 Mev FRASCATI AND 100 Mev ORINO ELECTRON SYNCHROTRONS. P. E. Argan Jniversità, Genoa and Istituto Nazionale di Fisica Nu- leare, Genoa), A. Gigli, E. Picasso, V. Bisi, G. Piragino, . Beneiscioli, and A. Piazzoli. Nuovo cimento (10), 17: uppl. No. 2, 215-40(1960). (In Italian)

The construction and the operation characteristics of wo large high pressure diffusion cloud chambers, of which ne operated in a magnetic field with a maximum value of bout 18,000 G, recently constructed by the Genoa Section f the I.N.F.N. are described. The scientific program for the uture is covered briefly and includes the utilization of the 100 Mev Synchrotron at Frascati and the 100 Mev Syn- hrotron at Torino. The auxiliary apparatus for the cham- ers, the methods for exposing them, together with the sys- em for analysis of the photographic records, are outlined. auth)

16542 THE DESIGN AND CONSTRUCTION OF A 29 Mev MICROTRON. D. K. Aitken, F. F. Heymann, R. E. Jennings, and P. I. P. Kalmus (University Coll., London). Proc. Phys. Soc. (London), 77: 769-85(Mar. 1, 1961).

The design and construction of a microtron having a 20-ton magnet with a pole diameter of 80 in. are described. Details are given of the major components; phase stability is considered, and the particle dynamics relevant to vertical focusing and to beam extraction are developed. This accelerator provides a mean extracted electron beam of about 10^{-8} amp at an energy of 29 Mev. The microtron is pulsed at 100 pulses/sec, and has an electron pulse duration of about 2 μsec. By use of a quadrapole lens system the extracted beam can be focused to a spot about 2 mm in diameter, with a corresponding angular spread of less than 1°. (auth)

16543 THE CYCLOTRON IN ŘEŽ STARTED OPERATION. Věstník Československ. akad. zemědělských věd, No. 3, 323-7(1960).

The first Czechoslovak cyclotron was put in operation at the Institute of Nuclear Research, Czechoslovak Academy of Sciences in Řež, on February 19, 1960. The cyclotron is capable of accelerating deuterons and alpha particles to energies of up to 12,500,000 and 25,000,000 ev respectively. Its magnet weighs 120 tons and its pole-shoes have a diameter of 120 cm. The maximum potential attainable between dees is 150,000 v. The high-frequency current is provided by a transmitter with a power comparable to that of the most powerful Czechoslovak radio transmitter. The deflector plate has a negative voltage of 70,000 v. The cyclotron accessories consist of water and power sources and high-capacity vacuum pumps. The cyclotron is cooled by distilled water supplied by an electrically heated distilling station. It uses 7.5 m^3 of distilled water removing 500,000 cal/h. The entire distilled-water equipment and piping is of stainless steel. The vacuum in the acceleration chamber, beam tubes and target room is obtained by prevacuuming pumps, and by diffusion vacuum pumps capable of increasing this vacuum to 10^{-7} mm of Hg. Power for the magnet and the high-frequency generator is provided by several rotary generators. The rooms housing cyclotron, extraction beam tube, and target have concrete walls 220 cm thick and heavy, double-walled steel-plate doors filled with aqueous borax solution. (auth)

Plasma Physics and Thermonuclear Processes

16544 (AERE-BIB-124(Rev.1)) UNITED KINGDOM ATOMIC ENERGY AUTHORITY AND ASSOCIATED BRITISH WORK ON CONTROLLED THERMONUCLEAR REACTIONS. A List of Unclassified documents and published articles. C. S. Sabel, comp. (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Sept. 1960. 47p.

A bibliography is presented, consisting of 418 references, associated with British work on controlled thermonuclear reactions. The revision takes account of published literature produced in 1960. The references are in alphabetical order of first author in two sections: books and general articles; and memoranda, reports, and patents. An author index is included. (B.O.G.)

16545 (AERE-R-3578) THE MEASUREMENT OF PRESSURE GRADIENT IN HIGH CURRENT DISCHARGES. M. G. Rusbridge (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Dec. 1960. 14p.

It is shown that the usual method of obtaining gas pressure distributions from magnetic field measurements gives very inaccurate results when applied to a system with toroidal symmetry. It is also inherently inaccurate for small gas pressures since it involves taking the difference of two large quantities. It is also shown, however, that errors due to fluctuations of the magnetic field are unlikely to be serious in practice. To eliminate these sources of error, a method is proposed involving the direct measurement of current density using a small Rogowsky coil. Experimental results demonstrating the feasibility of this measurement are given. (auth)

16546 (AFBMD-TR-60-114) THERMONUCLEAR PROPULSION RESEARCH. Semiannual Report, January 1–

June 30, 1960. (Space Technology Labs., Inc. Physical Research Lab., Los Angeles). Contract AF04(647)-309. 11p. (AD-245933; STL/TR-60-0000-09198)

A summary is given of the status of work on the super-fast pinch assembly which consisted mainly of monitoring the behavior of the plasma in the pinch tube with high-speed magnetic probes. The data obtained were classified and correlated. A transverse pinch assembly was constructed and tested. A field-free conducting plasma was compressed by a fast rising B_Z magnetic field and held radially stable for times which are long compared to axial escape times. Controlled plasma bouncing and second-cycle flux trapping were observed. The conical shock tube was used in a parametric study which has made it possible to formulate general ground rules for the design of this type of assembly. Work on the first model of the magnetically insulated shock tube was completed. A new plug-in streak unit for the image converter camera was completed. The unit aids in filling the gap between the writing rates of the image converter and the rotating mirror camera. (auth)

16547 (AFCRL-TN-60-983) MICROWAVE INVESTIGATION OF THE DIELECTRIC WAVEGUIDE PROPAGATION BY MAGNETO-IONIC DUCTS. Technical Summary Report No. 1. D. Formato and A. Gilardini (Sindel S.p.A., Rome). Apr. 30, 1960. Contract AF61(052)-145. 34p.

Magneto-ionic propagation in a cylindrical plasma of circular cross-section has been investigated theoretically and experimentally in a straight and in a curvilinear geometry. The microwave signal transmitted through a plasma generated from an r-f discharge in neon was measured as a function of the discharge power, the magnetic field, the gas pressure, and the pitch angle of the helical winding, used as a mode-selective input. The experimental results were explained by the theory of the magneto-ionic propagation in a ionized medium with a plasma frequency larger than the signal frequency. The theoretical results and their implications on the ionospheric interpretation of whistler atmospheric behavior are also discussed. (auth)

16548 (AFOSR-TN-60-1169) RADIATION FROM AN ELECTRIC DIPOLE IN AN ANISOTROPIC COLD PLASMA. Technical Report No. 24, Hans H. Kuehl (California Inst. of Tech., Pasadena. Antenna Lab.). Oct. 1960. Contract AF18(600)-1113. 57p. (AD-246496).

The general expression for the far-zone dyadic Green's function in an anisotropic medium is presented. The radiation of an electric dipole in a cold plasma is considered. Expressions for the far-zone radiation from a dipole are derived for the case of weak magnetic field and low plasma density and for the case of an infinite magnetic field. (auth)

16549 (CEA-1672) MODELE D'UN PLASMA SANS COLLISIONS DANS UNE GEOMETRIE CYLINDRIQUE PAR L'ETUDE DES MOUVEMENTS DE PARTICULES. (Model of a Plasma without Collisions in a Cylindrical Geometry by the Study of the Motions of the Particles). P. H. Rebut (France. Commissariat à l'Énergie Atomique, Paris). 1960. 39p.

The Boltzmann equation for a group of particles in the absence of collisions may be written $df/dt = 0$, where f is the distribution function in the phase space. The equation means that f is an individual motion constant. This leads to a study of the paths and of the first integrals of the differential system related to them. The study leads also to a confinement condition on the velocities of a particle. The following step is related to the theoretical study of some distribution functions and of the resulting consequences. A differential system is obtained, giving density, and magnetic and electric fields. The system was solved for a number of cases by a digital computer. The solution allo an experimental comparison to be made. The first integrals obtained are still valid when magnetic "screw-type fields are concerned, which results in obtaining a type of helicoidal deformation and of a stability criterium with r spect to the deformations. (auth)

16550 (LAMS-2529) QUARTERLY STATUS REPORT OF THE LASL CONTROLLED THERMONUCLEAR RESEARCH PROGRAM FOR PERIOD ENDING FEBRUARY 2 1961. (Los Alamos Scientific Lab., N. Mex.). Mar. 1961 Contract W-7405-eng-36. 49p.

The half-scale caulked picket fence experiment is in op ation. There did not appear to be any trapping of high-β plasma in the magnetic mirror configuration, while in the picket fence geometry there was trapping and containment of low-β plasma between the line and axial cusps. Time-resolved pressure distributions were measured in the fast hydromagnetic gun. Preliminary data were also taken on Columbus S-5, a fast dynamic pinch experiment. Energy balance calculations were made for several applied voltag discharges in Perhapsatron S-5 Zeus which indicated a negligible energy loss for the first 20 μsec. The "tail" in the skew trapping experiment was found to be spurious. A new idea for injecting and trapping energetic charged particles in magnetic mirror geometries was proposed. Theoretical calculations were made of the resonance condition for a simplified model and an electron experiment was set up. In the experiment on the scattering of microwaves by ionized gases, the dynamics of the plasma medium were detected both by incoherent scattering out of the main beam and phase modulation of the transmitted beam. A resonance in the intensity of the incoherent scattered beam was found which depends on gas pressure and electron density. Small azimuthal asymmeteris in the axia magnetic field were found to reduce the neutron yield in the Orthogonal Pinch Experiment by a factor of as much as 3. The effects of irradiation on the 4-electrode Marx gap were studied by applying a slowly rising trigger pulse to the probe of the center electrode. In connection with the Scylla experiment, the reflectivity of the beryl crystal of the soft x-ray spectrometer was measured. Scylla III with the standard Scylla I coil produced 10^8 neutrons during a discharge. The new plasma gun produced what appeared to be a dense, highly energetic plasma stream. Construction of the $E \times B$ accelerator is almost complete. A total of 16 of the 42 shelves of the Zeus capacitor bank was test fired at full voltage. Development work on the fast, parallel-plate capacitor resulted in improved designs. (M.C.G.)

16551 (NASA-TN-D-855) A STUDY OF LAMINAR COMPRESSIBLE VISCOUS PIPE FLOW ACCELERATED BY AN AXIAL BODY FORCE, WITH APPLICATION TO MAGNETOGASDYNAMICS. E. Dale Martin (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.). Apr. 1961. 69p.

A study is made of the steady laminar flow of a compressible viscous fluid in a circular pipe when the fluid is accelerated by an axial body force. The application of the theory to the magnetofluidmechanics of an electrically conducting gas accelerated by electric and magnetic fields is discussed. Constant viscosity, thermal conductivity, and electrical conductivity are assumed. Fully developed flow velocity and temperature profiles are shown, and detailed results of the accelerating flow development, including velocity and pressure as functions of distance, are given for the case where the axial body force is constant and for the case where it is a linear function of velocity. From these results are determined the pipe entry length and the pressure difference required. (auth)

52 (NP-10039) ELECTROMAGNETIC RADIATION M A SOURCE IN A PLASMA. G. W. Ford (Michigan. ., Ann Arbor). [1960]. 27p.

ne problem of determining the radiation field from a n charge-current distribution which is immersed in a ma in the presence of a uniform external magnetic field reated. The Maxwell equations in this medium are re- ed to a single but complicated partial differential equa- for the transverse part of the dielectric displacement d. This equation is solved for the asymptotic fields far n the source of radiation, and the results are discussed he low-frequency limit. The application of the results he problem of determining the low-frequency radiation n a radial burst of fast electrons (a crude approxima- of an atomic blast in the ionosphere) is also discussed. L.C.)

53 (NRL-5590) PENETRATION OF ELECTRO- GNETIC WAVES INTO IONIZED GASES. W. R. Faust val Research Lab., Washington, D. C.). Dec. 14, 1960.

Extension was made of the work of Reuter and Sond- mer on the anomalous skin effect to the study of the pen- ration of electromagnetic waves into a semi-infinite sma. Approximate expressions for the behavior of the ctric field under various limiting conditions are derived a Maxwell-Boltzmann distribution. (auth)

554 (ORNL-3066) EXACT RELATIVISTIC FOKKER- ANCK COEFFICIENTS FOR PLASMA AND RADIATION. ART] III. Albert Simon (Oak Ridge National Lab., Tenn.). ar. 30, 1961. Contract W-7405-Eng-26. 16p.

Exact relativistic Fokker-Planck coefficients, derived in previous paper for the case of a plasma composed of lectrons and infinite mass ions, are generalized to the se of an arbitrary number of finite mass ion species. uth)

555 (PPL-TR-60-16) THE EFFECT OF VARIABLE LASMA CONDUCTIVITY ON MHD ENERGY CONVERTER ERFORMANCE. W. B. Coe and C. L. Eisen (Republic viation Corp. Plasma Propulsion Lab., Farmingdale, . Y.). Oct. 1960. Contract AF 49(638)-552. 20p. (AFOSR- N-164)

An investigation was made in order to obtain solutions to set of differential equations governing the performance f the magnetohydrodynamic (MHD) energy converter with ne electrical conductivity of the plasma dependent on its ocal thermodynamic properties. Cesium vapor was chosen s the working fluid and the performance computed for 2 alues of entrance stagnation temperature, 2000 and 5000°K. he required entrance flow Mach number for maximum ower density increased as the entrance stagnation tempera- ure was increased. For the temperatures studied, the re- uired entrance Mach number was always subsonic. The ttainable power density increased sharply with increases n entrance stagnation temperature. (M.C.G.)

16556 (R60SD456) EXPERIMENTAL PERFORMANCE OF A PULSED GAS ENTRY COAXIAL PLASMA ACCELER- ATOR AND APPLICATIONS TO SPACE MISSIONS. B. Go- rowitz and P. Gloersen (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). Oct. 1960. Contract AF04(647)-269. 19p. (AD-245788).

The performance of a pulsed gas entry coaxial type plasma accelerator was evaluated by several experimental techniques. Impulse, kinetic energy, specific impulse, mass flow, and propellant species were investigated for single-pulse operation of the accelerator fired into an oversize test chamber pumped down to a pressure of 10^{-6} mm of Hg. Impulse was measured by the standard ballistic pendulum technique, while unidirectional kinetic energy carried by the plasma exhaust was measured by firing the accelerator into a calorimeter. The specific impulse was determined by two independent methods. The mass of propellant injected through the pulsed gas entry valve was measured and compared with the value derived from the impulse and kinetic energy measurements. Accelerated species were investigated spectroscopically. In addition to these measurements, Kerr Cell photography of the luminous plasma exhaust indicated a high ratio of unidirectional kinetic energy to thermal energy in the plasma exhaust as demonstrated by the small amount of lateral spreading of the plasma in the oversize test chamber. With 4500 joules stored in the capacitor bank, the performance of the accelerator is as follows: The calorimeter measurements indicate that at least 25% of the energy originally stored in the capacitor appears as unidirectional kinetic energy in the plasma exhaust (1125 joules). The impulse delivered to the ballistic pendulum under these conditions was 3950 dyne-seconds. The time-of-flight measurements indicate an average specific impulse of 6000 seconds, in agreement with the specific impulse deduced from the impulse and kinetic energy measurements. Rotating mirror camera records show that initial portions of the plasma emanate at a specific impulse of 30,000 seconds but that subsequent portions emanate at a specific impulse of 6000 seconds. It is shown that even on a typical space vehicle mission as short as 10,000 hours, the overall weight requirements for the pulsed plasma accelerator are far less than for a chemical rocket performing the equivalent mission. A description is given of a large vacuum facility constructed for the purposes of conducting tests on repetitively pulsed plasma accelerators operated at power levels up to 100 kw under conditions simulating those in outer space. (auth)

16557 (TID-11240) PLASMA TURBULENCE RESEARCH. Annual Report, July 20, 1959 to July 20, 1960. (Space Technology Labs., Inc. Physical Research Lab., Los Angeles). Contract AT(04-3)-321. 7p. (STL/TN-60-0000-AE191).

Activities during the period include a fundamental study of turbulent plasmas. Results indicate that the momentum equation for the mean flow contains extra stress terms contributed by the average double-velocity product (Reynolds stress). It was also concluded that the average (vector) product of turbulent velocity and magnetic field fluctuations (double correlation) gives rise to a macroscopic electric field that opposes the d-c electric current density. Turbulent energy equations indicate how the energy of the mean field is transferred and dissipated. (J.R.D.)

16558 (UCRL-6364) THE DYNAMIC PINCH AS A HIGH-INTENSITY LIGHT SOURCE FOR OPTICAL MASER PUMPING. S. A. Colgate and A. W. Trivelpiece (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 31, 1961. Contract W-7405-eng-48. 10p.

The optical radiation that occurs in a dynamic plasma pinch experiment depends in part on the amount and type of impurity atoms present in the system. By proper choice of these impurities, it should be possible to tailor the optical radiation from the pinch in intensity, spectrum, and duration such that the kinetic energy of motion (100 to 1000 joules) appears as radiation energy in less than 10^{-6} sec. This should provide a good method of optical pumping for pulse optical maser operation. The optical radiation from the dynamic pinch is discussed and an experiment that is being set up to use this radiation as the pump source for an optical maser is described. (auth)

16559 (USCEC-79-202) PLASMA PARAMETRIC AMPLIFIER. Jim Y. Wada and Zohrab A. Kaprielian (University of Southern California, Los Angeles. Engineering Center). Sept. 1960. 53p. (AFOSR-TN-60-1261; AD-247170)

The theory and application of plasmas as nonlinear reactance elements in parametric amplifiers are presented. The feasibility of parametric amplification is demonstrated by use of a quadrupole cavity model containing a plasma column. Analytical expressions for the power gain and noise figure are derived for the case in which the signal and idling frequencies are sufficiently separated and for the degenerate case in which these two frequencies are equal. The results and their limitations are discussed in some detail. (D.L.C.)

16560 (USCEC-83-204) INTERACTION BETWEEN A RADIO WAVE AND A PLASMA IN THE PRESENCE OF A UNIFORM MAGNETIC FIELD. Toyoki Koga (University of Southern California, Los Angeles. Engineering Center). Jan. 1961. Contract AF49(638)-831. 45p. (AFOSR-283)

Because of the imposed magnetic field, the effect of movements of ions is not to be neglected. Considering a plausible model of plasmas where molecules are partly ionized, Boltzmann type equations are proposed for ions and electrons. By introducing "generalized moments" of the distribution functions of electrons and of ions, it is easy to solve the equations, obtaining the conductivity of a plasma to an oscillating electric field. The propagation of a radio wave in the plasma is investigated. There are seven frequencies which characterize the phenomena: (i) Larmor's frequencies of electrons and of ions; (ii) frequency of radio wave; (iii) plasma frequency and a similar one defined with respect to ions; and (iv) collision frequencies of electrons and of ions. Considerations are given for the first approximation where frequency (iii) is negligibly small compared with frequency (ii), i.e., the electric field induced by the group displacements of electrons and of ions is neglected. As special cases, Alfven's theory of hydromagnetic waves and Margenau's theory of radio waves in plasmas with no imposed magnetic field are included. For the second approximation, the field induced by the group displacements of electrons and of ions may also be considered. (auth)

16561 (UTIA-63) THE OSCILLATING PLATE IN MAGNETOHYDRODYNAMICS. J. A. Steketee (Toronto. Univ. Inst. of Astrophysics). Aug. 1959. 35p.

The classical problem of the oscillating plane in a viscous incompressible fluid is extended to a fluid which is conductive while in addition there is a magnetic field perpendicular to the plane. In the problem appear two penetration depths which depend on the intensity of the applied magnetic field; if the two penetration depths are unequal when the magnetic field is absent, the effect of switching on the field is an increase in the larger penetration depth and a decrease of the smaller. Explicit answers are worked for the case of equal viscous and magnetic Reynolds number. The investigation suggests that boundary layer thicknesses in magnetohydrodynamics depend on the magnetic field intensity. (auth)

16562 (AEC-tr-4188) THE TOROIDAL APPARATUS WITH A STRONG MAGNETIC FIELD "TOKOMAK-2". V. S. Vasil'evskiĭ, V. S. Mukhovatov, V. S. Strelkov, and N. A. Yavlinskiĭ. Translated from a paper furnished by Soviet scientists on the occasion of the visit to Project Matterhorn in May, 1960. 18p.

The special construction features of the experimental apparatus Tokomak-2, designed for the investigation of Joule heating of a plasma in a strong longitudinal magnetic field, are described. The inner chamber of the apparatus is heated to a temperature of 400 to 450°C, and the investigations are carried out at the hot walls of the chamber. The double evacuation system permits the attainment of super high vacuum in a volume of ~500 liters. (auth)

16563 (AEC-tr-4217) INVESTIGATION OF THE CONTAINMENT OF A PLASMA IN A TRAP WITH MAGNETIC MIRRORS. PARTS I AND II. M. S. Ioffe, R. I. Sobolev, V. G. Telkovskii, and E. E. Yushmanov. Translated for Oak Ridge National Lab. from a paper presented to members of the U. S. Scientific Exchange Team on the occasion of their visit to the U.S.S.R. July 4-24, 1960. 58p.

A method of obtaining a plasma containing fast ions is described which makes it possible to fill a trap with a volume of 200 liters with a hydrogen plasma. Containment studies reveal that in addition to known types of ion losses including charge exchange there are additional ion losses which exceed charge exchange losses by 8 to 10 times. Experiments were conducted to measure directly the number of ions leaving the plasma to the mirror throat and the trap lateral wall. It was found that about 80% of the loss is to the lateral trap walls and about 20% through the mirrors. (J.R.D.)

16564 (AFCRL-TN-60-1150) ON THE QUESTION OF LIGHT SCATTERING BY A PLASMA. G. M. Avak'iants. Translated from Izvest. Akad. Nauk Uzbek. S.S.R., Ser. Fiz.-Mat. Nauk, No. 4, 89-92(1960). 6p.

A discussion is given of the type of scattered light associated with free electrons for which there exists the known Thomson formula referring to an electron initially at rest. Considerations are given for scattering plane-polarized light as well as natural light. The formulas derived refer to single scattering, in which the light quantum only collides once with an electron then leaves the plasma. Light scattered as a result of taking into account the dispersion character of the media is a series of lines which can be observed if the difference in the frequencies exceeds the Doppler broadening. In the opposite case, a confluent, anomalously broad line is observed. The plasma refractive index is not only a function of the light frequency, but of the number of excited atoms, electrons, ions, and molecules. (B.O.G.)

16565 (NP-tr-578) CONTRIBUTIONS TO THE THEORY OF SURFACE WAVES IN MAGNETIC HYDRODYNAMICS. A. D. Kislovskii (Kislovskiy). Translated from Vestnik Moskov. Univ., Ser. Fiz.-Mat. i Estestven. Nauk, No. 6, 99-106(1957). 10p.

16566 LINEARIZED MAGNETOGASDYNAMIC CHANNEL FLOW WITH AXIAL SYMMETRY. F. Edward Ehlers (Boeing Scientific Research Labs., Seattle). ARS (Am Rocket Soc.) J., 31: 334-42(Mar. 1961).

The equations for the axisymmetric flow of a conducting gas through a cylindrical channel in a magnetic field are linearized under the assumption of small magnetic Reynolds number and small values of the magnetic interaction parameter. Solutions for subsonic and supersonic flow are found by means of Laplace and Fourier integral transforms, and simple approximations are derived for the axial and wall perturbation velocities and the velocity profiles far downstream of the magnetic field sources. Some numerical calculations are given for subsonic flow through the magnetic field produced by a circular current loop concentric to the channel cross section. As a result of the imposed field, the flow is accelerated through the field near the channel axis and decelerated near the wall. No numerical calculations are given for supersonic flow, but the properties of the flow are discussed. (auth)

4567 THE FRONT OF AN ELECTROMAGNETIC AVE IN AN IONIZED GAS SUBJECTED TO A MAGETIC FIELD. Marialuisa De Socio. Atti acad. nazl. incei. Rend., Classe sci. fis., Mat. e nat., 28: 622-6 May 1960). (In Italian)

In a preceding work (Rendiconti Acc. Lincei ser. 8 27, 38(1959)) some results on a plane wave front propagated n an ionized gas subjected to a magnetic field were reorted. The results were obtained by solving the Maxwell quation with the laplacian transformation. The study is ompleted in the present work by considering that the dielectric constant of the gas remains constant. (J.S.R.)

6568 THE RADIAL OSCILLATIONS AND THE STABILITY OF A CYLINDRICAL PLASMA. R. Simon (Institut d'Astrophysique, Cointe-Sclessin). Bull. classe sci., Acad. roy. Belg. (5), 46: 674-85(1960). (In French)

The problem of the stability of a cylindrical plasma toward purely radial oscillations considered in a previous article (Bull. Acad. roy. Belg., 45: 595(1959)) is redissussed in terms of amended boundary conditions for the solutions of Maxwell equations in the infinite empty space surrounding the plasma. The case of a plane plasma layer which permits a complete analytical treatment suggests, for the case of cylindrical symmetry, the existence of asymptotic solutions which are discussed. (auth)

16569 ROTATING BEAM IN A LOW-PRESSURE DISCHARGE. J. Kracik (Czechoslovak Technical Univ., Prague). Československ. časopis pro fysiku, No. 5, 409(1960).

It is known that under certain conditions it is possible in a low-pressure discharge to obtain a bright beam which is rotating irregularly (or sometimes regularly). These conditions were investigated theoretically and experimentally. It was found that the appearance of a rotating beam necessitates the presence of negative ions in the gas filling of a discharge tube. The conditions necessary for the uniform rotation of a beam are that the negative ions have a low mobility. This was confirmed by means of a special discharge tube and it was found that the rotation can exist over a small range of currents. On the basis of the above investigation it was possible to explain the reasons for the inadequacy of some electric bulbs; it was found that one of the components of the solvent employed resulted in the appearance of heavy negative particles having a low mobility. (auth)

16570 PROPAGATION IN A PLASMA. P. A. Clavier (Ford Motor Co., Newport Beach, Calif.). J. Appl. Phys., 32: 578-82(Apr. 1961).

The boundary conditions for a radio signal incident normally on a layer of plasma are discussed. It is shown that 10 different modes must in general propagate in the layer, instead of the 6 usually assumed. The 10 modes are obtained when the Langevin form of the force is used in Boltzmann's equation. (auth)

16571 EXCITATION AND AMPLIFICATION OF CYCLOTRON WAVES AND THERMAL ORBITS IN THE PRESENCE OF SPACE CHARGE. R. Adler (Zenith Radio Corp., Chicago), A. Ashkin, and E. I. Gordon. J. Appl. Phys., 32: 672-5(Apr. 1961).

The effect of space charge on the motion of the entire beam and on the internal orbits of individual electrons in the transverse fields of cyclotron-wave amplifiers is considered. It is shown that the cyclotron-wave couplers excite the motion of the entire beam and have no influence on the internal motion. With sufficiently high space charge, the amplification of the cyclotron wave in quadrupolar fields is not accompanied by internal-orbit amplification. Experiments illustrating the difference between orbit pumping and wave pumping are described. It is concluded that space charge plays a vital role in allowing high gain without beam expansion and interception. (auth)

16572 PROPOSED DIAGNOSTIC METHOD FOR CYLINDRICAL PLASMAS. J. Shmoys (Polytechnic Inst., Brooklyn). J. Appl. Phys., 32: 689-95(Apr. 1961).

For a cylindrically symmetric plasma column whose electron density N is a slowly varying, monotonically decreasing function of radius r, it is possible to calculate explicitly both the diffraction pattern from the knowledge of N(r) and, conversely, N(r) from the knowledge of the diffraction pattern. If the diffraction pattern is obtained experimentally, N(r) can be calculated by a cumbersome numerical procedure. Instead of doing this, the diffraction pattern can be approximated by one of a family of convenient analytical expressions for which the integration can be carried out easily. Alternatively, N(r) may be inferred by assuming a functional form for N(r) with one or more parameters, calculating the diffraction pattern, and comparing it with the observed one. (auth)

16573 BACKWARD-WAVE MICROWAVE OSCILLATIONS IN A SYSTEM COMPOSED OF AN ELECTRON BEAM AND A HYDROGEN GAS PLASMA. R. Targ and L. P. Levine (Sperry Gyroscope Co., Great Neck, N. Y.). J. Appl. Phys., 32: 731-7(Apr. 1961).

A traveling-wave interaction structure is used to investigate the properties of a low-density plasma formed by the interaction of an electron beam with H gas. Microwave oscillations near the electron cyclotron frequency are observed as the result of growing waves in a beam-plasma interaction. Electron densities are determined by observing the correlation between the measured frequencies of oscillation and the theoretical predictions relating to backward-wave propagation in a beam-plasma system in a magnetic field. This electron density is verified by observation of the shift in the resonant frequency of a microwave cavity containing the plasma. The shift in the resonant frequency of the cavity gives a direct measurement of the electron plasma frequency and, hence, the electron density. (auth)

16574 BRILLOUIN FLOW IN RELATIVISTIC BEAMS. D. C. dePackh and P. B. Ulrich (U. S. Naval Research Lab., Washington, D. C.). J. Electronics and Control (1), 10: 139-46(Feb. 1961).

A solution is derived in closed form for Brillouin flow under relativistic conditions in a cylindrical geometry in the limit of low beam temperature. Density, magnetic field, energy and tangential velocity throughout the beam are studied. In particular it is found that the forward velocity is constant to all orders in the radial coordinate, that under ultra-relativistic conditions the beam of maximum perveance has a forward velocity approaching $c/\sqrt{2}$, and that the maximum current is proportional in the ultra-relativistic limit to the square of the energy of the outermost particles. (auth)

16575 THE STEADY STATE OF THE CHAPMAN-FERRARO PROBLEM IN TWO DIMENSIONS. J. W. Dungey (Pennsylvania State Univ., University Park). J. Geophys. Research, 66: 1043-7(Apr. 1961).

The steady state of the Chapman-Ferraro problem (flow of ionized gas near magnetic dipole) is formulated in mathematical terms, but the three-dimensional problem presents little hope of an analytical solution, and it is not even obvious how to compute the solution. The two-dimensional problem is reduced to a standard potential problem and

solved exactly. The solution is used to obtain an indication of the error in the flat-faced approximate model that has been used previously in three dimensions. (auth)

16576 ON THE STABILITY OF SOLUTIONS OF THE LINEARIZED PLASMA EQUATION. Richard Bellman (RAND Corp., Santa Monica, Calif.) and John M. Richardson. J. Math. Anal. and Appls., 1: 308-13(Dec. 1960).

The equation $u_t + ixu - iaf'(x)\int_{-\infty}^{\infty} u\,dx = 0$, $u(x,0) = h(x)$, is a linearized version of a basic equation in plasma physics. By deriving a relation equivalent to the usual dispersion relation, but of more convenient form, criteria for stability of solutions of this equation may be found. (auth)

16577 EFFECT OF A MAGNETIC FIELD UPON THE STABILITY OF FREE BOUNDARY LAYERS BETWEEN TWO UNIFORM STREAMS. Kanefusa Gotoh (Kyoto Univ.). J. Phys. Soc. Japan, 16: 559-70(Mar. 1961). (In English)

The stability of free boundary-layer flow in a viscous, incompressible, electrically conducting fluid is investigated. It is found generally that a uniform magnetic field parallel to the steady flow has an effect of stabilizing the flow. For weak magnetic field, i.e., for Alfvén number A <1, the flow is unstable with critical Reynolds number $R_c = 0$. For strong magnetic field such that A > 1, the flow is absolutely stable ($R_c = \infty$) provided $R_m/R > 1$ where R_m is the magnetic Reynolds number. For small values of R_m/R, the flows are unstable even for A > 1, so long as $(R_m/R)A^2 \ll 1$. It is also shown that an oblique magnetic field, however strong it may be, cannot stabilize the flow. (auth)

16578 AN ELECTROMAGNETICALLY CONTROLLED HIGH-VACUUM VALVE. István Berecz and János Schadek. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen). Közlemények, 2: 249-50(1960). (In Hungarian)

A high-vacuum valve has been developed for use with the particle accelerator now under construction at the Atomic Research Institute of Debrecen. The actuating mechanism is placed completely in the inner portion of the device thus obviating the necessity for a stuffing box for penetrating moving parts. Opening and closing the valve is accomplished by means of external electromagnets. The coils of the electromagnet, connected to a 48-v d-c source consist of 7500 windings of 0.6 mm diameter wire with an internal resistance of 69 ohm and a current of 0.7 amp. A tumbler switch is used to close the circuit and thus to actuate the valve itself. (TTT)

16579 CONVECTIVE INSTABILITY INDUCED BY GRAVITY IN A PLASMA WITH A FROZEN-IN MAGNETIC FIELD. William A. Newcomb (Univ. of California, Livermore). Phys. Fluids, 4: 391-6(Apr. 1961). (UCRL-6034-T).

The convective instability induced by gravity in a compressible fluid layer is investigated in the special case of a plasma with a frozen-in magnetic field B. The necessary and sufficient condition for stability, which is here derived from the hydromagnetic energy principle, is that the density gradient should exceed a certain critical value that is independent of B. Thus the rigidity given to the plasma by the frozen-in field does not suffice to remove the instability but only to slow it down. The growth rates of the unstable displacements are calculated by means of a normal mode analysis and are shown to be inversely proportional to B when B is sufficiently large. (auth)

16580 SUPERFAST PINCH STUDIES. Lee O. Heflinger and Stanley L. Leonard (Space Tech. Labs., Inc., Los Angeles). Phys. Fluids, 4: 406-23(Apr. 1961).

An apparatus designed to accelerate protons of a hydrogen plasma to energies of 1 kev or more by means of the radially converging magnetic piston of a longitudinal pinch was constructed. A capacitor charged to voltages of up to 350 kv is discharged through the plasma, producing curren of up to 75 ka. The ringing frequency is 18 Mc, so that the rate of current rise is about 0.8×10^{13} amp/sec. Radially converging luminous fronts with maximum velocities in excess of 50 cm/μsec are observed and are interpreted as shock waves driven by a magnetic piston. Magnetic probe measurements and measurements of the electric field at the wall of the discharge tube show that much of the magnetic flux introduced during the first half-cycle is trapped in the hot plasma. The effects of varying such parameters as the total current, the initial pressure of gas, the type of gas, and the frequency of the discharge were investigated. The experimental results are interpreted in terms of the classical Rosenbluth-Garwin theory of the pinch, which seems to correlate well with the observations. (auth)

16581 ENERGY LOSS FROM A TOROIDAL PINCH DISCHARGE. H. J. Karr, E. A. Knapp, and J. E. Osher (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 4: 424-37(Apr. 1961).

Most high-temperature plasma devices, and in particular pinch discharges, have energy-loss rates much larger than can be accounted for in terms of hydrogenic bremsstrahlung or quiescent plasma diffusion. This loss was investigated for a toroidal pinch discharge machine with longitudinal stabilizing magnetic field, Perhapsatron S-4. It is found that the major energy dissipation is due to vacuum ultraviolet emission from partially stripped impurity ions. The impurity is predominantly oxygen liberated from the walls of the tube into the discharge after the pinch was formed. Characteristics of this radiation are discussed, as well as a possible mechanism for the release of the impurity into the discharge. Comparisons between experimental results and theoretical predictions on the rate of radiation loss are given. (auth)

16582 QUASI-THERMALIZATION OF A PLASMA BEAM. Frank Salz and Russell G. Meyerand, Jr. (United Aircraft Corp., East Hartford, Conn.). Phys. Fluids, 4: 438-43(Apr. 1961).

A study of the trajectories of charged particles as they pass through a cusped magnetic field shows that a significant fraction of their original axial kinetic energy is transformed into kinetic energy of rotation around the guiding centers of the particles. The energy-exchange mechanism predicted by an idealized model agrees exactly with the analog computer solution of the equations of motion of a particle and agrees generally with the results of an experiment in which a plasma beam was transmitted through a cusped magnetic field. (auth)

16583 STABILITY OF AN INHOMOGENEOUS PLASMA IN A MAGNETIC FIELD. B. Lehnert (Royal Inst. of Tech., Stockholm). Phys. Fluids, 4: 525-6(Apr. 1961).

Charge separation caused by ion and electron clouds drifting with different velocities in the x direction is discussed. It is shown that a plasma region(1) of constant density $n(1-\theta)$ is initially divided from another region(2) of constant density n by a sharp sinusoidal boundary. The density gradient is then involved in the parameter $1-\theta$ which vanishes in the earlier theory. For cases where $\theta \ll 1$ the argument of the solution(1), which is valid in the initial phase ($ut \ll L$), is reduced by a factor $(\theta/2)^{1/4}$. This suppresses the growth rate considerably. When the separation ut becomes comparable with L the solutions are altered and a reversal of the electric drift may even take place. The shape of the ion and electron clouds can then be rep-

sented by a mixture of sinusoidal modes. A deduction milar to that by Rosenbluth and Longmire gives the space arge and the drift motions in terms of the perturbations. he stability of the system is determined by the parameter Oscillations with steadily increasing amplitude occur hen $\gamma > \frac{1}{4}$, whereas the amplitude is limited for $\gamma < \frac{1}{4}$. onsequently, a strong magnetic field gradient provides a rambling mechanism which smooths out the electric eld drift and may stabilize the system, at least for small sturbances. (N.W.R.)

16584 EXPERIMENTAL STUDY OF THE DIAMAGETISM OF GASEOUS PLASMAS WITH ELECTRON AND UCLEAR SPIN RESONANCE TECHNIQUES. T. C. Marhall and L. Goldstein (Univ. of Illinois, Urbana). Phys. ev., 122: 367-76(Apr. 15, 1961).

The occurrence of diamagnetism in active discharges as observed by measuring shifts in spin absorption resoance frequencies of foreign substances located near the lasma. Narrow spin electronic resonances in DPPH were sed to show that the magnetization of a gaseous discharge n low-pressure mercury vapor increases linearly with pplied magnetic field up to about 40 gauss, where maximiation occurs. Observation of the phase change in the armor precession of protons in a strong homogeneous ield showed that the diamagnetism in a modified Penning onization gauge (P.I.G.) discharge increased linearly with ower input and decreased approximately as 1/H. Irradiaion of the plasma with high-power microwaves with frequency near the free-electron gyrofrequency resulted in an increase of diamagnetism of the discharge. The discharge magnetic moment ranged from -0.001 to -0.32 erg/cm^3-gauss, depending on experimental conditions. The sensitivity of the nuclear resonance technique is one part in 10^6, and it permits observation of diamagnetism to be deferred until the discharge is over. The theory of plasma diamagnetism is summarized. (auth)

16585 ELECTRICAL BREAKDOWN IN HYDROGEN AT LOW PRESSURES. A. L. Ward (Diamond Ordnance Fuze Labs., Washington, D. C.) and Eifionydd Jones. Phys. Rev., 122: 376-80(Apr. 15, 1961).

Experimental and theoretical determinations of the static voltage-current characteristics, extending from the region of the Townsend (self-maintained) discharge to the normal glow discharge, were carried out in hydrogen at low pressures, (7 to 25 mm Hg). The calculations, made on an electronic computer, were based on the distortion of the electric field by space charge, and used the experimentally determined variation of both the primary and secondary Townsend ionization coefficients on the ratio of the field to pressure. Good agreement is obtained between the measured and calculated breakdown and glow voltages, and both the experimental and theoretical curves of the characteristic are of similar shape. (auth)

16586 RECOMBINATION IN A HELIUM PLASMA. A. F. Kuckes, R. W. Motley, E. Hinnov, and J. G. Hirschbert (Princeton Univ., N. J.). Phys. Rev. Letters, 6: 337-9(Apr. 1, 1961). (MATT-61)

It is experimentally confirmed that the rapid recombination observed in He plasmas is due almost entirely to 3-body collisions between He^{2+} ions and electrons. The 3-body recombination theory is found to predict the time dependence of the electron temperature T_e, but not the absolute value of T_e. (T.F.H.)

16587 ENERGY CONVERSION MECHANISM IN A BOUNDED MAGNETIZED CURRENT-CARRYING PLASMA. G. H. Joshi (Sylvania Electronic Systems, Waltham, Mass.). Phys. Rev. Letters, 6: 339-41(Apr. 1, 1961).

It is assumed that the coupling of the quasi-transverse electromagnetic (EM) waves and quasi-longitudinal space-charge waves simulates a traveling-wave tube type of interaction, so that kinetic energy can be interchanged with EM energy. The plasma is assumed to have the ability to support slow EM waves; for plasmas of electrons and one kind of ion near cyclotron frequencies, the plasma behaves in the required fashion. Using this mechanism, the EM energy and "runaway electron" energy may be used for plasma heating. (T.F.H.)

16588 THE EFFECT OF ELECTRODES IN A LINEAR PINCHED DISCHARGE. M. G. Haines (Imperial Coll. of Science and Tech., London). Proc. Phys. Soc. (London), 77: 643-56(Mar. 1, 1961).

A linear pinched discharge in fully ionized H or D is examined theoretically under idealized steady-state conditions of stability and balanced pressure and energy. Under these conditions, the Joule heating caused by the axial current is balanced by bremsstrahlung radiation losses and by axial heat conduction and diffusion to the electrodes. A partial analytical solution is found assuming that the transport coefficients have normal power dependencies on temperature (T) throughout the plasma. It is shown that all the energy not radiated is carried to the anode, the cathode having a negative total heat flux at its surface due to thermal effects of diffusion by the current-carrying electrons. The maximum T in the discharge is shown to vary directly with the voltage across the tube and only insensitively to other parameters. Relations are derived involving the dimensions of the discharge, the current and the maximum T. The variations along the axis of T, the line density, and the electric field are shown. The relative importance of heat conduction and radiation losses depends only on the total axial current which is flowing. An example of a discharge shows that temperatures of 10^6 to 10^7°K are feasible in the presence of heat losses to the electrodes. (auth)

16589 THE OHMIC HEATING OF POSITIVE IONS IN AN IMPURE PLASMA. A. A. Ware and J. A. Wesson (Associated Electrical Industries, Aldermaston Court, Berks, Eng.). Proc. Phys. Soc. (London), 77: 801-6 (Mar. 1, 1961).

It is shown that in a plasma heated by an electric current, the direct heating of the positive ions can be increased markedly by the presence of a small concentration of impurity ions. With favorable impurity concentrations, this heating is sufficient to explain the observed ion temperatures in ZETA and SCEPTRE. (auth)

16590 IMPROVEMENTS RELATING TO THERMONUCLEAR REACTORS. Robert Frederick Hemmings (to Associated Electrical Industries, Ltd.). British Patent 863,834. Mar. 29, 1961.

A toroidal thermonuclear discharge apparatus is designed with at least eight primary conductors extended around the torus. The conductors are arranged so that their fields substantially cancel in the discharge space and thereby reduce the chance of discharging the torus current to the wall. Various arrangements of the conductors are described. (D.L.C.)

16591 THERMONUCLEAR INJECTION PROCESS AND INJECTOR. (to U. S. Atomic Energy Commission). British Patent 865,082. Apr. 12, 1961.

A process and apparatus are described for increasing the energy of charged particles and for conducting controlled thermonuclear reactions. The process comprises establishing in an evacuated space a radially inhomogeneous, axially symmetric magnetic field with axially spaced intensified nodal reflector field regions. For increasing ener-

gies of charged particles, the field intensity is increased with time, and particles are disposed in a ring encircling the field so that they spiral radially inward to accumulate with increased energy in the central axial region. For controlled thermonuclear reactions, the magnetic field is increased in intensity sinusoidally with time and decreased in inhomogeneity. A ring of fuel plasma is introduced to the field at such a time that it is non-adiabatically heated, accumulated in the central axial region, and then adiabatically heated. The apparatus is assembled with solenoids, capacitor banks, and plasma fuel emitters. (D.L.C.)

Shielding

16592 THE INTERDEPENDENCE OF MANNED SPACECRAFT DESIGN AND RADIATION SHIELDING. L. J. Barbieri and S. Lampert (Ford Motor Co., Newport Beach, Calif.). Aero/Space Eng., 20: No. 4, 14-15(Apr. 1961).

The shielding requirements for an orbit 500 km above the earth's surface were determined from data presently available. It is pointed out that shielding a space vehicle for human occupancy depends upon many factors such as orbit and length of time in that orbit. The allowable radiation exposure of the occupants and the weight of the vehicle must receive primary consideration. Available data are reviewed for range-energy relationships of all radiations known to be encountered in space. The shielding properties of various materials are reviewed, and the relative merits of Al and Pb are considered in detail. It is concluded that shielding against protons presents the main problem. Calculations were made of the average radiation path length for high-energy protons or heavy particles through an average man, assuming that the man has the stopping power of water. A value of 50 cm was obtained, and it is shown graphically that all protons of energy equal to or less than 300 Mev will be completely absorbed by the average man. It is concluded that if sufficient shielding is provided to absorb 52-Mev protons in those regions of a space vehicle where the astronauts will spend most of the time in orbit, and provided the radiation flux is no higher than is believed at present, there is no reason why a 4-week flight is not possible from a radiation hazard viewpoint. It is pointed out that solar flares remain the greatest unknown. The need is stressed for a handbook showing the attenuation, degradation, and transmission of the several types of radiation through a variety of structural materials as functions of thickness, and for the breakdown of the number of particles per unit energy interval as a function of energy. (C.H.)

16593 COSMIC RAYS, NUCLEAR REACTORS, AND MANNED SPACE SYSTEMS. David Reitz (Martin Co., Denver). Aero-Space Eng., 20: No. 4, 28-9; 77-94; 96 (Apr. 1961).

Time variations and steady-state cosmic radiation conditions are presented. Steady-state biological intensities are given both for low-altitude orbits as functions of orbital inclination to the plane of the earth's equator, and for paths lying far above the earth's surface. Total allowable nuclear reactor radiations in the cosmic-ray background are next calculated as functions of satellite orbital inclination and exposure time. These reactor radiation intensities give no more than the recommended maximum doses as stipulated by the U. S. Committee on Radiation Protection. A method of obtaining minimum weight reactor shields also is outlined and applied in a hand computation for a nuclear 300-kw electrical system. (auth)

16594 SCATTERING SHIELDS FOR SPACE POWER. Carl N. Klahr (Technical Research Group, Inc., Syosset, N. Y.). Nucleonics, 19: No. 4, 110; 111(Apr. 1961).

Rocket reactor shielding techniques are examined, including the use of multiple shields, the shaping of shields, and the selective positioning of these shields to greatest advantage. Weight, heating effects, and configuration problems concerning shielding are discussed. Secondary radiation effects are noted. (T.F.H.)

16595 A CRITERION FOR THE SELECTION OF SHIELDING DIAPHRAGMS FOR MEASUREMENTS BY THE METHOD OF ATTENUATION OF BETA RADIATION. A. V. Klimushev and V. S. Merkulov. Priborostroenie, No. 10, 30-1(1960).

When using the method of attenuation of beta radiation for measuring the density of gases, it is frequently necessary to use shielding diaphragms. As the accuracy of measurement is reduced by these diaphragms, it is necessary to reduce their thickness. A corresponding decrease of the radiation flux leads to an increase of the statistical error in the recording of radiation. These factors are considered for an optimum selection of the dimensions of shielding diaphragms. (auth)

16596 PRINCIPLES OF PERSONNEL RADIATION SHIELDING. Gerhard Breitling (Universität, Tübingen, Ger.). Röntgen Bl., 14: 65-72(Mar. 1961). (In German)

On the basis of the intensity distribution of Compton's scattered radiation, the possibilities of danger offered by scattered rays of various radiation qualities are indicated. As an example, the distribution of dose on the diagnostic apparatus is presented, and measures for the reduction of the load are discussed. The dependence of the scatter and back-scatter on the tube voltage and the atomic number of the scattering material is described. In conclusion, the suitability of various building materials for shielding purposes is briefly mentioned. (auth)

16597 SHIELD FOR NEUTRON PROBES. (to Siemens Schuckertwerke). Belgian Patent 572,809. Nov. 29, 1958. (In French)

Both the neutron probe and its shield are located between the reactor core vessel and the biological shield. In front of the probe is a plate capable of absorbing γ rays; the probe is further protected by a moderating layer, a reflecting layer, and a strong neutron absorber. (EURATOM)

Theoretical Physics

16598 COLLECTIVE OSCILLATIONS IN AN ELECTRON GAS OF METALLIC DENSITY. THE CORRELATION ENERGY. [PART] I. Jan Sledzik (Inst. of Physics, Academy of Sciences, Poland). Acta Phys. Polon., 20: 3-22(1961). (In English)

The subsidiary conditions in the Bohm-Pines theory of an electron gas are analyzed. These conditions must be expressed in the form of 2 sets of operator identities. The first set establishes the Bohm-Pines subsidiary condition operators, and the second set validates the commutators of the extended Hamiltonian and of the first set. The extended Hamiltonian and the 2 sets of subsidiary conditions are proved to be equivalent to the n-electron Schroedinger equation. The 2 sets of operators enable, at least theoretically, replacement of a certain number of electronic positions and momenta by coordinates and momenta of a longitudinal field describing the long-range density fluctuations. The assumption is made that a certain number of excited electron-hole pairs and the collective response to them—

the rearrangement of the charge—may be described by a certain effective longitudinal field as introduced by Bohm and Pines. In the theory thus formulated, the total number of degrees of freedom of the system is correct and no subsidiary conditions are required. The Hamiltonian and the ground state function are the same as in the Bohm-Pines theory, but the number of individual electrons is smaller. The correlation energy obtained is several times smaller than that of Bohm-Pines. The theory proposed is valid within the alkali metal density range. (auth)

16599 COLLECTIVE OSCILLATIONS IN AN ELECTRON GAS OF METALLIC DENSITY. THE CORRELATION ENERGY. [PART] II. Jan Sledzik (Inst. of Physics, Academy of Sciences, Poland). Acta Phys. Polon., 20: 23-42(1961). (In English)

In order to isolate the plasmons in the Bohm-Pines type extended Hamiltonian, the canonical transformation to independent plasmon modes is applied. The formula obtained for the correlation energy is nearly the same as that of the Gell-Mann and Brueckner high density electron gas theory. The absolute value of the constant in the correlation energy is by 4% larger than in the Gell-Mann and Brueckner approach. The second order energy shift within the Rayleigh-Schroedinger perturbation theory framework is evaluated. (auth)

16600 THE EQUATIONS OF MOTION OF CLASSICAL CHARGES. F. Rohrlich (State Univ. of Iowa, Iowa City). Ann. Phys. (N. Y.), 13: 93-109(Apr. 1961).

The problem of the physical solutions of the Dirac equation for classical charges is not the usual initial value problem of Newtonian dynamics where the motion is determined by initial position and velocity. Asymptotic conditions must simultaneously be fulfilled. This undesirable feature is eliminated if one uses a set of integro-differential equations of second order as the basic equations of motion. These are equivalent to the Dirac equation together with the asymptotic conditions, and pose a Newtonian initial value problem with no further conditions. The "principle of undetectability of small charges" which states that in the limit $e \to 0$ the motion of a charged particle must approach the motion of a neutral particle of the same mass can be shown to be valid on the basis of these equations, a fact, which is not generally valid for the solutions of the Dirac equations. A successive approximation procedure is developed valid for a large class of external forces. The "noninstant" character of the new equations is discussed and is shown to be observable in principle. But causality is not violated within the domain of validity of classical electrodynamics. One obtains a consistent theory which can have physical solutions in agreement with experiments for all nonquantum mechanical problems. (auth)

16601 ON THE DISTINGUISHABILITY OF EQUIVALENT POTENTIALS. Mirza A. Baqi Bég (Univ. of Birmingham, Eng.). Ann. Phys. (N. Y.), 13: 110-25(Apr. 1961).

The possibility of discriminating between equivalent potentials is explored by making use of three-body amplitudes. Working with a simple model of a two-body target, and making approximations characteristic of a high-energy treatment, it is found that the three-body amplitude can be decomposed into two parts; one sensitive to the nature of the two-body force, the other expressible in terms of two-body observables. When the two-body interaction terminates exactly beyond a certain distance a, the first part arises entirely from the overlap of the target particles if they are regarded as spheres of radius a. By consideration of effective range theory a brief discussion of potentials with infinitely long tails is also given. For such interactions the second part of the composite amplitude is always zero. In order to avoid extensive digressions into the problem of potential construction, specific discussion is restricted to the two classes for which this problem is solved, namely, local and nonlocal separable potentials. (auth)

16602 INCONSISTENCY OF THE LOCAL FIELD THEORY OF CHARGED SPIN 3/2 PARTICLES. Kenneth Johnson (Massachusetts Inst. of Tech., Cambridge) and E. C. G. Sudarshan. Ann. Phys. (N. Y.), 13: 126-45(Apr. 1961).

The relativistic quantum theory of Fermi-Dirac fields of arbitrary spin is investigated, and a general theorem is proved which asserts that for fields of half-integral spin $>1/2$, the possibility of a consistent quantization requires that the equal-time anticommutators must be functions of the other fields to which the field in question is coupled. The case of spin $3/2$ is studied in detail, and the equivalence of various formulations of the theory is shown. The inconsistency of the relativistic local quantum theory of a charged spin $3/2$ field in interaction with an external electromagnetic field is demonstrated by showing that the equal time commutation relations and relativistic covariance of the theory are not compatible. Finally, the mixed spin $3/2$-spin $1/2$ (Bhabha) field is found to be characterized by the same inconsistency. (auth)

16603 PROBLEM OF RAINICH FOR SCALAR FIELDS. Asher Peres (Israel Inst. of Tech., Haifa). Bull. Research Council Israel. Sect. F, 9F: 129-31(Dec. 1960). (In English)

The conditions that have to be imposed on a symmetric tensor, so that it can be considered as the energy-momentum tensor of a scalar field, are determined. (auth)

16604 ON QUANTUM MECHANICAL SYSTEMS WITH STOCHASTIC HAMILTONIAN OPERATOR. H. Primas (Laboratorium für Physikalische Chemie der ETH, Zurich). Helv. Phys. Acta, 34: 36-57(1961). (In German)

The theory of quantum mechanical systems with a stochastic Hamiltonian which are of importance in the theory of dissipative systems and in experimental investigations of the response of physical systems by means of electronic devices is discussed. A new formal development of quantum mechanical density matrices is given that is valid even for strong stochastic perturbations. If the stochastic part of the Hamiltonian has a Gaussian distribution and an almost constant spectral density the given solution reduces to an expansion in terms of Hermite functionals which are othonormal respective to the Wiener measure (Cameron-Martin development). This expansion is operationally meaningful and characterized by good convergence and simple properties. As an example of the application of the theory a new foundation of Bloch's relaxation theory is sketched. (auth)

16605 RELATION OF PERTURBATION THEORY TO VARIATION METHOD. Oktay Sinanoglu (Yale Univ., New Haven). J. Chem. Phys., 34: 1237-40(Apr. 1961).

The various order wave functions of the Rayleigh-Schrödinger perturbation theory can be obtained directly by solving certain differential equations or by minimizing equivalent variational expressions. These expressions are related to the ordinary variation method. The perturbation series is shown to result in a unique way from the minimization of larger and larger portions of $(\psi, H\psi)/(\psi, \psi)$. In addition to several orders of perturbation, each step gives the exact remainders and upper limits to the energy. The approach suggests several "variation-perturbation" schemes. (auth)

16606 QUANTUM STATISTICS OF SURFACE EFFECT. Takuji Tsuzuki (Yokohama Municipal Univ., Japan). J. Phys. Soc. Japan, 16: 377-92(Mar. 1961). (In English)

The quantum mechanical behavior of a dilute gas in a vessel with finite volume are considered with special reference to the surface effect. It is shown that the thermodynamic function of the system with weak interactions between particles can be expanded in terms of permutation rings. The result is shown to be in harmony with that derived from the method of grand partition function. An approximate treatment for molecules with hard cores is also given. (auth)

16607 EQUIVALENCE THEOREMS AND RENORMALIZATION PROBLEM IN VECTOR FIELD THEORY (THE YANG-MILLS FIELD WITH NON-VANISHING MASSES). H. Umezawa (Université d'Aix-Marseille, France) and S. Kamefuchi. Nuclear Phys., 23: 399-429(Mar. 1961). (In English)

Equivalence theorems are derived for the Yang-Mills field with non-vanishing masses and for the electrodynamics of vector fields. A general theory of the Stueckelberg formalism is also presented. On the basis of these theorems the renormalizability problem is discussed for the above cases. It is concluded that quite contrary to the case of a single real vector field, the theory is not renormalizable even when the source current of the field is strictly conserved. The origin of the non-renormalizability can always be traced back to the mass terms. Theorems are further generalized to the case of the intermediate vector particle theory of weak interactions. (auth)

16608 CONCERNING A "STRONG" COUPLING METHOD IN THE QUANTIZED FIELD THEORY. Yu. (Ju.) M. Lomsadze (Univ. of Uzhgorod, Ukraine SSR). Nuclear Phys., 24: 143-50(1961). (In English)

A new approximate method especially intended for "strong" coupling variants is proposed for solving the equation of motion in quantized field theory. This method revives the idea of the old "strong" coupling method, with the essential difference that in the new method use is made of the exact reduction of the interaction Hamiltonian of quantized fields to diagonal form, without "fixing" the nucleon current. (auth)

16609 CAUSALITY AND THE LORENTZ GROUP. M. Neuman (Univ. of California, Berkeley). Nuovo cimento (10), 19: 433-66(Feb. 1, 1961). (UCRL-9260) (In English)

A definition of causality, different from the one currently employed in field theory, is introduced; its relations to the Lorentz group and to relativity theory are clarified. This causality leads to a reduction of the S-matrix of dispersion theory that is not subject to some limitations previously encountered. The mathematical constructions appearing in the course of this reduction are discussed. (auth)

16610 GENERAL RELATIVITY WITHOUT COORDINATES. T. Regge (Princeton Univ., N. J.). Nuovo cimento (10), 19: 558-71(Feb. 1, 1961). (In English)

An approach to the theory of Riemannian manifolds is developed that avoids the use of coordinates. Curved spaces are approximated by higher dimensional analogs of polyhedra. It is noted that this procedure enables condensation of the essential features of topologies like Wheeler's wormhole into a simplified model. (auth)

16611 MINIMAL ELECTROMAGNETIC COUPLING FOR SPIN TWO PARTICLES. P. Federbush (Massachusetts Inst. of Tech., Cambridge). Nuovo cimento (10), 19: 572-3 (Feb. 1, 1961). (In English)

If the same Lagrangian that describes the linearized theory of general relativity is extended to charged massed spin 2 particles, it is noted that the coupling cannot be minimal electromagnetic. (auth)

16612 GREEN'S FUNCTION IN SOME COVARIANT SOLUBLE PROBLEMS. S. Okubo (CERN, Geneva). Nuovo cimento (10), 19: 574-85(Feb. 1, 1961). (In English)

Examples of soluble covariant field theory are given, in which there is no scattering but in which the Green's functions are non-trivial. Exact expressions for the Green's functions are obtained, and in each case they show a peculiar behavior on the light cone. Some cases exhibit the ghost-like trouble. In one case, it is shown that Lehmann's proof for the spectral representation of the two-body Green's function fails. All examples given here contradict Haag's theorem and the significance of this contradiction is pointed out. (auth)

16613 GENERALIZED GAUGE INVARIANCE AND STRONG INTERACTIONS. V. Gupta (Tata Inst. of Fundamental Research, Bombay). Nuovo cimento (10), 19: 586-93(Feb. 1, 1961). (In English)

The principle of generalized gauge invariance, which postulates that boson fields and their interactions with the fermion fields be introduced only through demanding the invariance of the free fermion Langrangian under gauge transformations, is assumed to be valid. If renormalizability is made a further fundamental criterion to be satisfied by the interactions (obtained through generalized gauge transformations), meson-baryon strong interactions with only pseudo-scalar coupling can be obtained. (auth)

16614 ON THE POSSIBLE GENERALIZATIONS OF PLANCK'S LAW. M. Strauss (Deutsche Akademie der Wissenschaften, Berlin). Nuovo cimento (10), 19: 594-6 (Feb. 1, 1961). (In English)

It is suggested that a third universal constant l be added to quantum field theory, in addition to h and c. It is proposed that the h-c-l theory might explain mass spectra and give coupling constants. Using the h-c-l form of Wien's law and thermodynamic postulates, an h-c-l form of Planck's law is derived. (T.F.H.)

16615 FURTHER REMARKS ON THE PROPOSED μ-e SELECTION RULE. N. Cabibbo and R. Gatto (Università, Rome and CNEN, Rome). Nuovo cimento (10), 19: 612-14 (Feb. 1, 1961). (In English)

Additive and multiplicative μ-e selection rules are considered. It is found that certain reactions, such as $\mu \rightarrow e + \gamma$, $\mu \rightarrow e + e + e$, and μ + (nucleus) $\rightarrow$ e + (nucleus), are forbidden under both selection rules, while other reactions, including $e^+ + \mu^- \rightarrow e^- + \mu^+$ and $e^+ + e^+ \rightarrow \mu^+ + \mu^+$ are forbidden by the additive law, but allowed by the multiplicative law. It is proposed that several of these reactions be studied for determination of the additive or multiplicative nature of the μ-e selection rule. (T.F.H.)

16616 ANALYTICAL METHODS IN HARTREE-FOCK SELF-CONSISTENT FIELD THEORY. H. Huzinaga (Univ. of Chicago). Phys. Rev., 122: 131-8(Apr. 1, 1961).

Two alternative schemes are proposed for the determination of electronic self-consistent field (SCF) orbitals in atoms and molecules. They are designed to be applied principally to electronic configurations consisting of two open shells. Both schemes are based upon the idea that the SCF orbitals are expanded in terms of adequate basis functions but they are different in the way of solving the SCF problem. An attempt is made to rate relative merits of both schemes, though they have not yet received any actual application. (auth)

16617 NONLINEAR ELECTRODYNAMICS IN GENERAL RELATIVITY. Asher Peres (Israel Inst. of Tech., Haifa). Phys. Rev., 122: 273-4(Apr. 1, 1961).

General relativistic field equations are derived from a gauge-invariant electromagnetic Lagrangian, which does not involve derivatives of the field, nor any charge density, but otherwise is completely arbitrary. These equations are explicitly solved in the static spherically symmetric case, and it is shown that there are solutions which are everywhere regular and behave, at large distances, like the gravitational and electromagnetic fields of a point charge. Some wave-like solutions are also derived. (auth)

16618 TIME-ORDERED GREEN'S FUNCTIONS AND ELECTROMAGNETIC INTERACTIONS. K. Nishijima (Univ. of Illinois, Urbana). Phys. Rev., 122: 298-306 (Apr. 1, 1961).

Various aspects of the Ward-Takahashi equations are studied. In perturbation theory the equivalence between this set of equations and the requirement of gauge invariance is shown. It is then shown that these equations are valid for composite particles as well as for elementary particles. Based on our new formulation the definition of composite particles is given, and then we show with the aid of the Ward-Takahashi equations that the photon is an elementary particle. (auth)

16619 MANDELSTAM REPRESENTATION WITH ANOMALOUS THRESHOLDS. R. J. Eden (Cambridge Univ., Eng.), P. V. Landshoff, J. C. Polkinghorne, and J. C. Taylor. Phys. Rev., 122: 307-12(Apr. 1, 1961).

It is proved that fourth-order diagrams provide necessary and sufficient conditions for the Mandelstam representation to be valid for every finite order in perturbation theory. (auth)

16620 TIME-ORDERED GREEN'S FUNCTIONS AND PERTURBATION THEORY. M. Muraskin and K. Nishijima (Univ. of Illinois, Urbana). Phys. Rev., 122: 331-40 (Apr. 1, 1961).

A formulation of field theories based on the generalized unitarity condition and parametric dispersion relations is presented. In the perturbation theory we discuss the connection between the present scheme and the Lagrangian theory and derive the renormalizability condition in our formulation. Finally we show for typical processes in the first, second, third, and fourth orders that our theory can reproduce the renormalized Feynman perturbation theory. (auth)

16621 VARIATION-PERTURBATION METHOD FOR EXCITED STATES. Oktay Sinanoğlu (Univ. of California, Berkeley). Phys. Rev., 122: 491-2(Apr. 15, 1961). (UCRL-9316).

The first-order wave function, X_1, in the perturbation method can be obtained by a variational principle instead of summing the usual infinite series with a large continuum contribution. For a ground state or the lowest state of a given symmetry suitable trial functions, $\tilde{X}_1$, are chosen to attain E_2, the second-order contribution to the energy, as a minimum. This method is extended here to any excited state, m, regardless of its symmetry. To obtain X_1^m, the expression $\tilde{E}_2^m = \{2[\Phi_0^m, (H_1 - E_1^m)\tilde{X}_1^m] + [\tilde{X}_1^m, (H_0 - E_0^m)\tilde{X}_1^m]\} \geq E_2^m$, is to be minimized with $\tilde{X}_1^m$ in the form $\tilde{X}_1^m = \bar{X}_1^m + \sum_{k=0}^{m-1} \frac{\Phi_0^k [\Phi_0^k, H_1 \Phi_0^m]}{(E_0^m - E_0)}$, with $\bar{X}_1^m$ orthogonal to the known unperturbed functions of the states lower than m. The X_1 gives also the third-order energy. The method may be applied to such excited states as (1s2s) ^{1}S of He-like ions and to the similar electron pairs that arise in the writer's theory of a many-electron atom or molecule. (auth)

16622 PERTURBATION THEORY OF MANY-ELECTRON ATOMS AND MOLECULES. Oktay Sinanoğlu (Univ. of California, Berkeley). Phys. Rev., 122: 493-9(Apr. 15, 1961). (UCRL-9320).

Perturbation theory with operator techniques is applied to a nondegenerate many-electron system taking the entire electron-electron repulsions, $\Sigma_{i>j} r_{ij}^{-1}$, as the perturbation. The first order wave function X_1, is obtained rigorously in terms of the first order wave functions of independent two-electron systems. The wave functions of these electron pairs contain nuclear parameters and can be obtained individually by variational or other methods, then used in various atoms or molecules. For example Li atom is built up completely from the $(1s)^2$ ^{1}S, (1s2s) ^{1}S and ^{3}S states of Li^+. The X_1 gives the energy to third order and as an upper limit to the exact E. The E_2 is equal to the sum of complete pair interactions plus many-body terms of two types: (a) "cross polarization," which exists even in no-exchange intermolecular forces, and (b) Fermi correlations. (auth)

16623 MAGNETIC FIELD DEPENDENCE OF THE SUPERCONDUCTING ENERGY GAP. D. H. Douglass, Jr. (Massachusetts Inst. of Tech., Lexington). Phys. Rev. Letters, 6: 346-8(Apr. 1, 1961).

The magnetic field dependence of the superconducting energy gap (ϵ) is derived by means of the Ginzburg-Landau phenomenonological superconductivity equations. These equations permit the calculation of ϵ for strong magnetic fields. The results are applied to thin evaporated films and bulk matter. (T.F.H.)

16624 THREE BODY COLLISIONS IN QUANTUM MECHANICS. P. Résibois (Université Libre, Brussels). Physics, 27: 33-47(Jan. 1961). (In English)

The 3-body collision problem is studied, using a technique based on the Liouville equation in the classical case and on the Von Neumann equation in the quantum case. The dynamics of the problem are expressed in terms of the Von Neumann equation, which leads directly to a definition of the transition probability. The expansion parameter is chosen to be the number of "binary kernels," where a binary kernel describes exactly a 2-body collision between intermediate states. It is shown that for hard sphere collisions at low energy, these "binary kernels" can be evaluated explicitly. The convergence of the "binary kernel" expansion for the 3-body collision problem is discussed. (T.F.H.)

16625 ON THE RUIJGROK-VAN HOVE MODEL. B. D. Fairlie (Pembroke Coll., Cambridge, Eng.). Physica, 27: 95-8(Jan. 1961). (In English)

The model due to Ruijgrok and Van Hove is studied for a particular choice of coupling constants. The resulting theory displays an exact criterion for the existence of ghost states. In the limit as the number of intermediate states increases to simulate a realistic field theory the ghost behavior disappears. (auth)

16626 ON THE CALCULATION OF THE t-MATRIX FOR POTENTIALS WITH A HARD CORE. J. M. J. Van Leeuwen (Instituut voor Theoretische Physica, Amsterdam) and A. S. Reiner. Physica, 27: 99-110(Jan. 1961). (In English)

An explicit calculation of the t-matrix for general complex argument is described for potentials consisting of a chain of rectangular wells. Details are given for the hard sphere interaction and the Herzfeld potential. The method is compared with the resolvent method, stressing the caution needed when a hard core is present in the interaction. (auth)

16627 THE ISOBARIC TRIPLETS IN THE NUCLEAR 2p-SHELL AND THE CHARGE INDEPENDENCE OF NU-

CLEAR FORCES. W. M. Fairbairn (Coll. of Science and Tech., Manchester, Eng.). Proc. Phys. Soc. (London), 77: 599-609(Mar. 1, 1961).

The positions of the lowest lying T = 1 levels in the 2p-shell nuclei with $T_3 = 0$ are calculated from the experimental positions of the ground states of the nuclei with $T_3 = +1$ and the energy differences between the ground states of the nuclei with $T = \frac{1}{2}$. Coulomb forces are considered as a perturbation in the shell model. The corrections due to symmetry are of the same order of magnitude as the significant differences that Wilkinson found between the experimental and the calculated positions of the T = 1, $T_3 = 0$ levels, and when these corrections are included the differences are no longer significant. The energy shift due to the charge dependence of nuclear forces caused by the pion mass difference is calculated and is shown to be appreciable. There is good agreement between theory and experiment for the isobars with A = 14. (auth)

16628 THE HARTREE PERTURBATION METHOD FOR HELIUM. A. Dalgarno and J. M. McNamee (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 77: 673-6 (Mar. 1, 1961).

The Hartree perturbation method is used to calculate the dipole polarizability (α_d), the electric field at the nucleus, the quadrupole polarizability (α_q) and the nuclear shielding factor of He using a 12-term representation of the unperturbed Hartree wave functions. The method yields lower bounds for α_d and α_q. The absolute error in the predicted values of any of the quantities is less than 4.3%. (auth)

16629 NUCLEAR AND RELATIVISTIC EFFECTS IN ATOMIC SPECTRA. A. P. Stone (Clarendon Lab., Oxford). Proc. Phys. Soc. (London), 77: 786-96(Mar. 1, 1961).

The electronic Hamiltonian for a general atom in the center-of-mass system is obtained as far as terms in $1/c^2$ and m/M_A by reducing a relativistic wave equation with 4 components for each electron and nucleon to an approximately relativistic form with 2 components per particle. The presence of non-Hermitian terms in the reduced Hamiltonian is explained. Relativistic corrections to the Coulomb and nuclear interactions and the effect of the intrinsic magnetic moments are treated by first-order perturbation theory. The hyperfine structure (hfs) interaction is obtained by expressing all electron–nucleon terms as multipole expansions, giving the previously known hfs expansion with recoil corrections. The exact operator for the nuclear field effect in isotope shift is obtained from the Coulomb interaction. The presence of other corrections depending on nuclear structure is indicated. The normal mass effect calculation in isotope shift is investigated for non-s-electron configurations and is shown to be justified if 0.1% of the spin-orbit interaction and the whole of the other relativistic perturbations are negligible in comparison with the term value. (auth)

16630 THEORY OF FINITE NUCLEI IN STATISTICAL METHOD WITH CORRELATION CORRECTION. [PART] I. Yasuo Hara (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 24: 1179–94(Dec. 1960). (In English)

A statistical method for atomic nuclei is developed in which the effective potential is the density-dependent nonlocal reaction matrix in nuclear matter. This method is applied to the calculation of the surface thickness, t, and the surface energy, E_s, of heavy nuclei. The results are: $t = (2.8 \text{ to } 3.0) \times 10^{-13}$ cm and $E_s = (23 \text{ to } 28)A^{2/3}$ Mev. (auth)

16631 ON THE METHOD OF THE THEORY OF NUCLEAR FORCES. Mitsuo Taketani and Shigeru Machida (Rikkyo Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 24: 1317-24(Dec. 1960). (In English)

The method of the theory of nuclear forces proposed by Taketani, Nakamura, and Sasaki is developed to clarify the present stage of the theory and to discuss the aims, as well as the important results already obtained, of the theoretical investigations in progress. (auth)

16632 COLLISION BROADENING OF THE LANDAU LEVELS. Tokio Ohta and Tohru Miyakawa (Defence Academy, Yokosuka, Japan). Progr. Theoret. Phys. (Kyoto), 24: 1378-80(Dec. 1960). (In English)

A tentative method is proposed in order to avoid the divergence of the scattering probability of a carrier by the static impurity potential in a magnetic field at the bottom of each Landau subband. The conventional assumptions such as "uncertainty cutoff" and "collision cutoff" are not used. The unit volume of the crystal is taken, a spherical mass is assumed, and all the spin-effects are ignored. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

16633 (AAEC/E-57) A TWO-GROUP ANALYSIS OF A FINITE FULLY REFLECTED CYLINDRICAL REACTOR. J. Thompson (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Dec. 1960. 11p.

A method is developed for the calculation of the critical size or effective multiplication constant of a fully reflected cylindrical reactor with a uniform core and uniform reflectors, using two-group theory. Solutions of the basic differential equations are superimposed, and boundary conditions satisfied by the use of orthogonal functions. The method appears suitable for a small digital computer. (auth)

16634 (AE-42) HETEROGENEOUS CALCULATION OF ϵ. Alf Jonsson (Aktiebolaget Atomenergi, Stockholm). Feb. 1961. 25p.

A heterogeneous method of calculating the fast fission factor given by Naudet was applied to the Carlvik-Pershagen definition of ϵ. An exact calculation of the collision probabilities was included in the program developed for the Ferranti-Mercury computer. (auth)

16635 (AEEW-R-50) A REPORT ON THE FIRST LOADING OF ZENITH. R. M. Absalom, V. E. Della Loggia, J. E. Sanders, F. R. Barclay, W. Hage, L. I. Tiren, I. R. Cameron, G. H. Kinchin, and D. J. Wilson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England). Dec. 1960. 78p.

The loading to criticality of the first core of the zero energy reactor ZENITH and the results of the subsequent experimental program are described. The composition of the reactor core corresponds to graphite/U^{235} and Th^{232}/U^{235} ratios of 3843 and 9.51, respectively. (auth)

16636 (BAW-1207) SUPPLEMENT TO THE GAS-SUSPENSION TASK III. Final Report. (Babcock & Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Oct. 31, 1960. Changed from OFFICIAL USE ONLY Nov. 30, 1960. Contract AT(30-1)-2316. 142p.

The gas suspension loop was used to obtain additional heat transfer and pressure drop data for circular flow geometries, using He and N_2 suspensions. The results show good agreement with correlations developed in Task III, and correlations were developed for new flow channel geometries, i.e., larger tubular channels with turbulence promoters and an annular channel. It is shown that the pumping power required to obtain a given film coefficient with He and N_2 can be reduced by a factor of 15 and 25, respectively, by adding powdered graphite. If the pumping power is a fixed percent of the heat removal rate, gas suspension can increase the heat removal rate over a pure gas by a factor of ~30. A fission product distribution study made with Kr^{85}, Rb^{86}, and Br^{82} indicates that powdered graphite will absorb considerable quantities of alkali metals and halogens present in fission products. (D.L.C.)

16637 (CEA-1681) ETUDE D'UN ELEMENT CONBUSTIBLE EN OXYDE D'URANIUM GAINE D'ALUMINUM, TYPE "CRISTAL DE NEIGE" POUR LA PILE EL 3. (Design of the Fuel Element "Snow-Flake," Uranium Oxide, Canned in Aluminum, for the Experimental Reactor El.3). M. Gauthron and B. Guibert (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1960. 33p.

A summary is presented of the main studies carried out on the fuel element "Snowflake" (uranium oxide, canned with aluminum), designed to replace the present element of the experimental reactor EL 3 to increase the reactivity without modifying the neutron flux/thermal power ratio. (auth)

16638 (CF-61-3-105) EPITAPH—A REACTOR FUEL COST CALCULATION. L. L. Bennett (Oak Ridge National Lab., Tenn.). Mar. 21, 1961. 13p.

EPITAPH is an economics calculation which was written to investigate nuclear fuel cycle costs as a function of various cost parameters. The fuel cost was broken down so that the user may easily study the effect of various cost parameters on the total fuel cost. Items entering into the total fuel cost include the value of the initial fuel material, the cost of converting the fuel to the chemical form desired in the fuel elements, the cost of fabricating fuel elements, the cost of shipping the fuel elements to and from the reactor, the cost of recovering the fissile and fertile material from the spent fuel, the cost of converting the recovered material to a form suitable for storage or return for credit, use charges on the fuel and interest charges on working capital, and credit received for the recovered fissile and fertile material. The reactor core loading, initial and final fuel composition, and the total energy generated are also utilized in the calculation. (auth)

16639 (CRRL-989) INVESTIGATION OF THE X-5 LOOP FLOW TUBE COLLAPSE. R. O. Sochaski, W. N. Selander, and E. C. Carlick (Atomic Energy of Canada Ltd., Chalk River, Ont.). Dec. 1960. 34p. (AECL-1188).

A description is given of the X-5 loop, its operation before and after failure, removal operations, and post-failure examinations. It is concluded that the cause of failure was a large pressure drop over the test section which created an excessive differential pressure across the flow tube wall. Recommendations for future operation are given. (auth)

16640 (CRT-993) A SEMI-NUMERICAL SEMI-ANALYTICAL METHOD FOR THE TWO-GROUP THEORY OF XENON OSCILLATION CALCULATIONS FOR NUCLEAR REACTORS. B. Davison (Atomic Energy of Canada Ltd., Chalk River, Ont.). Jan. 1961. 42p. (AECL-1193)

The possibility of using a mixed numerical-analytical approach for calculating the variations in flux, iodine, and xenon in reactors is considered. The position dependence is treated numerically and the time dependence analytically. An iterative procedure is developed in which, in the zero approximation, the eigenvalue problem is linear in the parameter and the eigenvalue is real, so that usual numerical methods can easily be used. The numerical calculations embodying the iterative procedure are outlined. (D.L.C.)

16641 (HW-53496) POWER LEVEL AND ENRICHMENT LIMITATIONS OF THE HANFORD TEST PILE. A. W. Thiele (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 12, 1957. 10p.

Flux levels were determined for the Hanford Test Pile by measuring the current from several ion chambers with a galvanometer. From these measurements, calculations were made of total power level. Results indicated that maximum power levels of the order of 10,000 watts and maximum irradiations of 10,000 watt-hours are permissible. Enrichment of the Test Pile with up to 100 inhours of calculated strength of enrichment was found to be permissible using certain procedures. The radiation levels to be expected at various points in the building are listed. (M.C.G.)

16642 (HW-61900-B) CRITICAL TESTS FOR PRT REACTOR. J. R. Triplett, J. K. Anderson, R. E. Dunn, R. E. Peterson, J. J. Regimball, J. T. Russell, L. C. Schmid, and W. H. Wolf (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 1, 1960. Contract AT(45-1)-1350. 102p.

Critical tests to be performed on the Plutonium Recycle Test Reactor are described. Exponential, approach-to-critical, critical, and substitution experiments will be carried out. These experiments include: calibration of moderator level; determination of the worth of various fuel loadings; calibration of the shim system including determination of maximum control strength of the entire system; substitution experiments to determine reflector savings, void effects, effects of H_2O and degraded D_2O coolants, and effects of loop and other material installations; determination of fuel-plus-coolant and moderator temperature coefficients; and kinetic experiments to determine response of the reactor to reactivity changes. (M.C.G.)

16643 (HW-66623) PROPOSED STUDIES ON THERMAL NEUTRON SPECTRUM. F. G. Dawson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 6, 1960. Contract AT(45-1)-1350. 4p.

The objectives are described of a program designed to make available codes for calculating the thermal spectra for hydrogen- and nonhydrogen-moderated systems; to compare the codes with other analytical methods and to evaluate them by correlations with experimental data; and to determine the spectral characteristics of Pu–H_2O systems for various hydrogen-to-plutonium ratios. (B.O.G.)

16644 (IDO-16638) PERTURBATION MEASUREMENT OF $1/\beta_{eff}$ USING A 1/v ABSORBER. A. H. Spano (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 3, 1961. Contract AT(10-1)-205. 19p.

A description is given of the experimental measurement of the prompt-neutron lifetime parameter of a SPERT water-moderated and -reflected reactor using the 1/v-absorber perturbation technique. The $1/\beta_{eff}$ result given by the experiment is compared with the dynamic value obtained from super prompt-critical power excursion experiments performed on the same core. The latter value is found to be constant throughout the reciprocal reactor period range $0 < \alpha < 300$ sec^{-1}; consequently, the comparison permits an evaluation of the static 1/v-absorber method in terms of the direct step-transient technique. (auth)

16645 (JAERI-1016) ANALYSIS OF THE DUCT RUPTURE ACCIDENT AT THE TOKAI ATOMIC POWER STATION, BY AN ANALOGUE COMPUTER. Report No. 16. Yasumasa Togo and Hiroshi Sugimoto (Japan Atomic Energy Research Inst., Tokyo). Sept. 19, 1960. 25p.

The maximum credible accident at the TOKAI POWER STATION (a Calder Hall type, natural uranium gas-cooled reactor) was considered to be an accident associated with the gas duct rupture. Variations in pressures and flow rates of gas coolant loops were analyzed by means of a d. c. analog computer, and various methods of detecting a ruptured duct were compared, based on the analysis. As for the magnitude of the ruptured parts, three equivalent rupture areas, 100, 300, and 1,000 cm^2, which correspond to the ruptures of connection pipings to the main duct, were assumed. The d. c. analog computer used in this computation was PACE A. (auth)

16646 (JAERI-4005) NUMERICAL TABLES AND CHARTS USEFUL FOR THE STUDY OF THE DYNAMIC BEHAVIOR OF THERMAL REACTORS. Report No. 5. Junichi Miida and Nobuhide Suda (Japan Atomic Energy Research Inst., Tokyo). 1959. 36p.

Charts and tables are included which are useful in determining the dynamic behavior of thermal reactors, subject to an arbitrary change in reactivity, from the standpoint of safety evaluations, control system designs, operations, and determination of reactor parameters. Transfer functions for characteristic values of the effective neutron lifetime, l, are given in the form of Bode's diagram. (auth)

16647 (NYO-2677) HETEROGENEOUS REACTOR CALCULATION METHODS. Quarterly Progress Report No. 5, April 1–June 30, 1960. Carl N. Klahr and Lawrence B. Mendelsohn (TRG, Inc., Syosset, N. Y.). Contract AT(30-1)-2375. 56p.

Considerations pertaining to the effect of the finite size of the fuel elements–large source theory–on the kernels used in heterogeneous calculations are explored. The use of kernels going from the spatially distributed sources in one fuel element to spatially distributed sinks within another fuel element permits one to consider complex fuel elements with detailed interior structure. Self-effects of the fuel elements are calculated for some simple geometries. The effect of rod interactions on the kernels is considered and a simple homogenization recipe is given to take such interactions into account to first order. A comparison is made between heterogeneous calculations and experiments on critical configurations in a graphite lattice. The calculated reactivities agree with the experimental values to the extent expected. Heterogeneous calculations of control-rod configurations in a graphite lattice are presented. The results indicate that both in reactivity and in power distortion, control-rod effects are quite sensitive to the control-rod pattern. Calculations on spiking effects are given. (auth)

16648 (ORO-342) FUEL-BEARING FIBERGLAS IN ALUMINUM-BASE FUEL ELEMENTS. Summary Report, May 4, 1960–October 31, 1960. R. H. Baskey and R. D. Johnson (Clevite Corp. Mechanical Research Div., Cleveland). Dec. 2, 1960. Contract AT(40-1)-2557. 133p.

Aluminum-coated glass fibers composed of plate glass or depleted uranium-bearing RX-70 glass were processed into core material by hot pressing or cold pressing followed by hot pressing and then fabricated into aluminum-clad fuel plates. The RX-70 fiberglas had an average composition of 44.4 percent aluminum by volume and 55.6 percent glass by volume. Hot-pressed composites containing RX-70 fibers oriented parallel to the applied stress exhibited excellent tensile strength retention properties at elevated temperatures. With few exceptions, the tensile strength was relatively constant varying from 18,850 psi to 24,000 psi over the temperature range from 400 to 1000°F. The same material containing fibers oriented perpendicular to the applied stress exhibited a decreasing tensile strength with increasing test temperature. The unclad fabricated fiberglas (uranium-free) core material had tensile strengths up to 22,000 psi at room temperature; the elongation and reduction in area were normally less than 1%. The unclad material usually bent only 7 to 10 degrees around a ¼-inch radius. Cladding either type of fiberglas-reinforced aluminum

h 1100, 6061, or 5154 aluminum increased the formility to the extent that it could be bent up to 90 degrees ound an identical radius without breaking. This clad terial exhibited reductions in area up to 57% and elontions up to 11% at 1000°F. Tensile strengths up to 30,650 i were measured at room temperature. Alclad 6061 ites containing RX-70 fiberglas-reinforced aluminum re sections exhibited tensile strengths at 600°F which re ~50% greater than either the conventional aluminumid, Al–U alloy fuel plates or commercial grade 6061 uminum. Alclad-fiberglas-reinforced aluminum was also nployed as a cladding material for an RX-70 fiberglasinforced aluminum core section. This method resulted improved core uniformity and eliminated the "dog ning" because the yield strength of the cladding and core aterial was almost identical at the rolling temperature 1000°F. The tensile strengths were comparable to uminum-clad Al-U fuel plates, although less than alclad 061 plates containing RX-70 fiberglas-reinforced aluminum re sections. The processing has been developed to the int where composite fuel plates are being produced which e blister free. The core uniformity with respect to imensions, the fuel distribution and the core end contour re comparable to standard MTR fuel plates. (auth)

16649 (P-1713(RAND)) A DISCUSSION OF THE CORELATION OF CRITICAL CONDITIONS FOR BARE HOMOGENEOUS REACTORS. Benjamin Pinkel and George B. W. Young (RAND Corp., Santa Monica, Calif.). June 4, 1959. 5p.

For presentation at the American Nuclear Society Annual Meeting, Gatlinburg, Tennessee, June 15-17, 1959.

An investigation was conducted to determine whether simple parameters could be found which could correlate the critical conditions for bare homogeneous reactors. In connection with this, a study was made of the results of an 18-group analysis which covered a group of reactors using Be, BeO, C, D_2O, Li^7H, and H_2O as moderators, over a wide range of moderator-to-uranium (U-235) mole ratios. The correlation was applied to the results of several criticality experiments. (B.O.G.)

16650 (TID-7592(p.13-33)) USE OF THORIUM OXIDE SUSPENSIONS IN AQUEOUS HOMOGENEOUS NUCLEAR REACTORS. D. G. Thomas (Oak Ridge National Lab., Tenn.).

Of the many possible configurations for achieving high-thorium-concentration aqueous blankets for homogeneous reactors, two are receiving consideration. These are (1) the fluidized solids system in which the fertile material is retained in the blanket region and (2) the circulating suspension system in which the ThO_2 slurry is circulated through the pump, heat exchanger, and associated components. Experience at the Oak Ridge National Laboratory is predominantly with the circulating slurry system, using ThO_2 with particle size less than 5 μ. Elevated-temperature circulation studies show that there is essentially no attack on loop piping and long-radius elbows for velocities up to 20 ft/sec. Problems that have been noted are largely of a design and development nature, e.g., elimination of stagnant regions to improve inventory control and careful attention to regions where slurry changes direction rapidly and to high-velocity regions in order to eliminate serious erosive attack problems. The principal consequence of the small sizes of ThO_2 particles is that the slurry is flocculated and may be considered as having a yield stress that must exceeded before flow can be initiated. The two principal factors affecting the yield stress are the ThO_2 particle sizes and concentrations (the larger the concentration and the smaller the particle size, the larger the yield stress). Experimental studies show that turbulent flow pressure drop and heat-transfer results can be correlated on the basis of experimentally measured laminar flow properties of the slurry. Preliminary results of drop-out velocity studies show two distinct regions of behavior: (1) the high-concentration region in which the slurry has an extremely small settling rate (i.e., the compaction region) and (2) a more dilute concentration region in which the slurry has an appreciably greater settling rate (i.e., a hindered-settling region). (auth)

16651 (TID-12489) A CROSSCORRELATION METHOD FOR MEASURING THE IMPULSE RESPONSE OF REACTOR SYSTEMS. J. Douglas Balcomb, Elias P. Gyftopoulos (Massachusetts Inst. of Tech., Cambridge), and Howard B. Demuth (Los Alamos Scientific Lab., N. Mex.). [1960?] 29p.

A crosscorrelation method for the study of the small signal response of nuclear reactor systems is presented. The technique and equipment necessary for the implementation of the method are discussed. Results from experiments performed on the Godiva and Kiwi-A3 reactors are reported. The experiments showed that the method gives very satisfactory results under adverse experimental conditions. (auth)

16652 (WAPD-NRFA-RPT-517) SN2010–EXTRA. A XENON TRANSIENT DATA REDUCTION CODE FOR THE IBM-650. Frank E. Gatewood, Jr. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Aug. 1960. Contract At-11-1-GEN-14. 26p.

SN2010–EXTRA is an IBM-650 code to reduce xenon transient test data. The code requires an augmented IBM-650 with automatic floating-point arithmetic and index registers. Average running time is less than one minute per measurement. A measurement consists of all the data for one rod configuration. During a xenon transient test, the buildup and subsequent decay of the xenon present in the reactor is followed by determining the times that different control rod settings are just critical. The reactivity decreases as the xenon concentration increases until eventually the period becomes negative. BF_3 detectors follow the change in neutron population. The pulses from the detectors are counted, and the counts plus time and run number are scanned and punched into paper tape automatically. Static data consisting of information and control parameters are recorded manually. The data are converted to reactivity values which are then treated by a linear least square curve fit routine to determine the time of criticality, i.e., when reactivity is zero; and the time rate of change of reactivity. Rod worths are calculated for successive measurements. (auth)

16653 (WTR-49) REPORT ON WTR FUEL ELEMENT FAILURE APRIL 3, 1960. (Westinghouse Electric Corp. Testing Reactor, Waltz Mill, Penna.) July 7, 1960. 135p.

The fuel element failure in the Westinghouse Testing Reactor on April 3, 1960 is described including a description of operating conditions and the sequence of events before, during, and after the occurrence. A thermal and hydraulic analysis of the incident is presented together with an interpretation of the observed data and a determination of burn-out heat flux for the operating conditions. Also included are the results of the inspection of cold fuel elements on hand and the programs to date in the examination of the failed fuel element. The cause of the failure was not established beyond reasonable doubt, but it was believed that a normal fuel element operating under the specified test conditions would not have failed. (M.C.G.)

16654 TIGHTNESS TESTS ON REACTOR SAFETY PRESSURE SHELLS. Kurt Jaroschek and Erich Weippert (Technische Hochschule, Darmstadt, Ger.). Brennstoff-Wärme-Kraft, 13: 105-15(Mar. 1961). (In German)

Various types of reactors require a pressure- and gas-tight shell. With the very strict tightness standards, the pressure test, which in itself is simple, is made very difficult because of the influence of temperature and humidity on the pressure inside the shell. Various methods of examination are compared. The tightness tests carried out with the pressure shells of the research reactors DIDO and MERLIN of the atomic research plant of the Land of North-Rhine-Westphalia near Juelich are used as examples to indicate the problems arising in the field of instrumentation. Using the test method in which the change of the absolute pressure is measured as a function of time, it is possible to achieve a satisfactory accuracy of measurement during a period of a few days at a reasonable cost. (auth)

16655 SOLUTION OF n-GROUP BOLTZMANN TRANSPORT EQUATION FOR HOMOGENEOUS CHAIN REACTING SYSTEM. Hisashi Hishida (Osaka Univ.), Tokuo Suita, and Tamotsu Sekiya. J. At. Energy Soc. Japan, 3: 83-8(Feb. 1961). (In English)

In a hydrogen moderated system, neutrons may be slowed down to the thermal energy region through only few collisions and the feed-back effect is of considerable importance. The time-dependent n-group Boltzmann transport equation is solved for the infinite homogeneous medium including the fission source under the assumption that moderation is due to elastic scattering with hydrogen atoms. The time-dependent solution is given in the form of a series of hypergeometric functions. The requirement for the stationary condition leads to the criticality equation and the stationary solution gives the energy spectrum. How the ordinary four-factor formula is related to the criticality condition hereby obtained is explained. The delayed neutron function has an effect upon the steady state neutron spectrum but not upon the criticality condition. The velocity dependency of the neutron energy spectrum is found to be of v $(\Sigma^{\alpha}-\Sigma^{2}/2)$ for every group. (auth)

16656 NATURAL CONVECTION FLOW IN LIQUID-METAL MOBILE-FUEL NUCLEAR REACTORS. Frederick G. Hammitt and Elayne M. Brower (Univ. of Michigan, Ann Arbor). J. Eng. Power, 83: 170-6(Apr. 1961).

No directly applicable theoretical or experimental results are available for natural convection in vertical liquid-metal filled ligaments encountered in mobile-fuel fast power reactor concepts. However, it is possible to delineate the general nature of behavior expected with respect to temperature, velocity, and wall heat flux profiles from limiting analyses and available experiments. It is shown that natural convection may be of importance from the viewpoints of perturbation of wall heat flux distribution (a limiting design condition), and motivation of velocities important as a possible mechanism for mass transport, and hence is also an influence on fission gas disposition. It does not appear that natural convection will substantially affect temperature differentials in the cases of interest. These can be estimated assuming pure conduction. (auth)

16657 MEASUREMENT OF LAPLACIANS BY THE METHOD OF PROGRESSIVE REPLACEMENT. P. Bacher and R. Naudet (Centre d'Études Nucléaires, Saclay, France). J. Nuclear Energy, Pt. A. Reactor Sci., 13: 112-27(Jan. 1961). (In French)

The progressive replacement method described is suited to this objective since it is a differential method. It is much cheaper and quicker than the usual critical experiment, but has comparable accuracy. It is shown how this method is applied to heavy water lattices in the critical facility 'Aquilon' and to graphite lattices during start-up experiments of the G1 and G2 reactors in Marcoule. (auth)

16658 THE HOMOGENIZATION OF HETEROGENEOUS REACTORS. C. Carter (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Energy, Pt. A Reactor Sci., 13: 145-9(Jan. 1961). (In English)

The proof of the homogenization method for an infinite reactor lattice is extended to the case of the finite bare reactor lattice. It is shown that homogenization is rigorously valid only for a rectangular reactor in which the reactor boundary has a certain specified relationship to the lattice, but that homogenization is a good approximation in any reactor containing a large number of lattice cells. The applicability of Wigner's second fundamental theorem to a heterogeneous reactor is discussed. (auth)

16659 THE DOPPLER EFFECT IN THERMAL REACTORS. R. M. Pearce (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Nuclear Energy, Pt. A Reactor Sci., 13: 150-75(Jan. 1961). (In English)

Experimental and theoretical work on the Doppler effect in thermal reactors is reviewed for U metal, UO_2, Th metal, and ThO_2. The experimental values of α, the fractional increase in resonance capture per °C, have a spread many times the quoted errors. The use of different slowing-down spectra contributes to the discrepancies. For U metal, approximate corrections are made to obtain the coefficient α_0 appropriate to a 1/E spectrum. The spread in the corrected values α_0 is smaller than that for α, but remains unsatisfactory. Other experimental difficulties arise in reactivity normalizations, in obtaining the statistical weight of samples, and from spurious temperature effects. Theory and experiment agree on an increase of α_0 with increasing surface-to-mass ratio and that this is caused by an increase in the contribution of lower-energy resonances to the Doppler effect. It is also in agreement with the theoretical interpretation of the radial dependence of the Doppler effect in a lump. However in the region of practical interest where the surface-to-mass ratio is small, α_0 is almost constant. Experimental evidence on the temperature behavior of α_0 is unsatisfactory but indicates that α_0 decreases with increasing temperature. Theory predicts that α_0 will vary approximately as $T^{-1/2}$ where T is the Kelvin temperature. In the case of non-uniform temperature distribution in a fuel element, both experimental and theoretical effort is needed. (auth)

16660 IRRADIATION TECHNIQUES FOR FISSILE MATERIALS. [PART] 4. O. S. Plail (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Power, 6: No. 60, 101-3(Apr. 1961).

Important aspects of irradiation programs, including temperature measurements, instrumentation, rig safety, out-of-pile testing, and laboratory simulation work are discussed. An idea is given of the complex laboratory development required for irradiation experiments with fissile materials. (T.F.H.)

16661 GAS CHROMATOGRAPH MONITORS REACTOR FOR FUEL FAILURES. William R. Kritz (E. I. du Pont de Nemours and Co., Aiken, S. C.). Nucleonics, 19: No. 4, 106; 108(Apr. 1961).

A gas-chromatographic device is described for monitoring Xe and Kr activity in reactor coolants, as a method of detecting reactor fuel element failures. High efficiency is achieved by stripping the radioactive atoms from the coolant with He. (T.F.H.)

62 TECHNOLOGIA JADROWYCH PALIW WYPALCH. (The Technology of Irradiated Nuclear Fuels). Czyslaw Taube. Warsaw, Office of the Government missioner for the Use of Nuclear Energy, 1960. 770p. Polish)

umerous tables, plots and drawings aid in giving a well nized presentation of the subject matter. The energetic chemical aspects of fission of heavy nuclei are covered, owed by the nuclear properties of the transradon (acles) elements. Included here is the history of the dis- ery of actinides, natural and artificial creation of the opes, and spontaneous as well as induced nuclear reacs. The chemical properties of the actinides are given rough treatment which begins with the place of actinides he order of known elements, and includes the physical, mical and radioactive properties of metallic actinides, d compounds, etc., states of oxidation in solids, in er and organic environment, degree of oxidation, solu- ty, decomposition in various environments, preparation ctinides, analytical methods, physiological effects, and thods of laboratory practice. The section covering nu- ar fuels includes enrichment, utilization, temperature ects, thermal conductivity, breeding, burnup, regenera- n and reclamation of solid fuels, liquids, gaseous fuels, rries, etc., and includes thermonuclear fuels as well. el cycle discussion follows covering burnup and breeding the many reactor types and fuel cycles generally known. liscussion of the technology of irradiated nuclear fuels ludes the reclamation of fuels by chemical separation m fission products and build-up elements, the disposal waste, high temperature reclamation processes such as lten salt and liquid metal environments, and the separa- n of the various trans-actinium elements. The separation fission products is also covered. Spent fuel processing ants are discussed from many points of view including rsonnel hazards, deactivation of apparatus, waste dis- sal, geographic factors, buildings, equipment, power re- irements, personnel and costs for research-type and dustrial-type separation plants. The various existing ants in the world are discussed in the light of these con- derations. This is followed by a discussion of general onomic problems of reactor power plants and reproc- sing plants including transport of electrical power, the st of production and isotopic separation of uranium orium and plutonium, and the earth's resources of ura- um and thorium. A large list of references is given. TT)

16663 RADIATION PROOF AND GAS TIGHT REACOR WITH ON-LOAD INTERCHANGEABLE FUEL ELEENTS. (to Brown Boveri & Cie). Belgian Patent 571,924. eb. 2, 1959. (In French)

Reactor, cooling circuit, heat exchanger, and auxiliary quipment are enclosed in a vessel consisting of two steel hells separated by a concrete radiation shield. The interediate space between steel and concrete is swept by a onactivable gas which is filtered continuously. Fission roducts from burst-slugs cannot escape the vessel. EURATOM)

16664 NUCLEAR REACTOR WITH CANNED FUEL ELEMENTS. (to Sulzer Freres). Belgian Patent 572,515. Apr. 30, 1959. (In French)

In order to improve efficiency, one central, enriched fuel element is surrounded with a number of natural uranium uel elements. All fuel elements are tubular, and the coolng medium is in contact with their inner and outer walls. (EURATOM)

16665 PRESSURIZED REACTOR SHELL. J. Bellier and A. Coyne (to Commissariat a l'Energie Atomique). Belgian Patent 572,860. Priority date, Nov. 26, 1957. (In French)

A single cylindrical concrete shell ensures both biological protection and mechanical resistance, thus making the reactor more compact; two hemispheres, with their concavity facing the outside of the shell, limit the cylinder. Internal pressure is counterbalanced by several clusters of stressed steel cables around or within the concrete shell; cast iron blocks reduce friction between cables and concrete. A thin steel sheet constitutes a leakproof lining inside the concrete shell. (EURATOM)

16666 SELECTIVE DETECTION OF FISSION PRODUCTS IN A GASEOUS FLOW. J. Goupil and A. Roguin (to Commissariat a l'Energie Atomique). Belgian Patent 573,559. Priority date, Dec. 4, 1957. (In French)

The main application of the invention is directed toward burst-slug detection in gas-cooled reactors. The reactor cooling gas is tapped and subjected to a continuous monitoring for radioactivity. Long-lived solid fission products responsible for considerable background noise are eliminated by filters. Short-lived gaseous fission products, mainly active Kr and Xe, contained in the cooling gas are then allowed to settle in a transit chamber and decay into Rb and Cs ions before being trapped by an electrode submitted to a high d-c negative voltage. The reading given by a device such as a phosphor with a multiplier is then compared to the readings obtained when the electrode is not energized. (EURATOM)

16667 NUCLEAR REACTOR. (to DECUSSA). Belgian Patent 579,367. Priority date, June 13, 1958. (In French)

The nuclear reactor consists of a vacuum-tight vessel enclosing a number of fuel elements and surrounded by a circulating coolant. The fuel elements are made of a hollow moderating substance such as graphite into which the molten fuel is poured. The heat is radiated from fuel to coolant without contact. (EURATOM)

16668 NEUTRON REACTOR. (to Rederiaktiebolaget Nordstjernan). Belgian Patent 581,046. Aug. 14, 1959. (In French)

A heterogeneous reactor is made up of a cylindrical pressure vessel containing blocks of solid moderator inside which are vertical cooling channels. These cooling channels are fitted with rods consisting of a central fuel element surrounded by a solid moderating substance. Fuel and moderator are separated by a suitable material preventing the diffusion, to the outside, of fission products. It is claimed that the absence of metallic framework and cans improves the neutron economy of the reactor. (EURATOM)

16669 MODERATOR FOR NUCLEAR REACTORS. F. van Hecke. Belgian Patent 584,041. Apr. 27, 1960. (In French)

The viscosity and heat transfer properties of the organic moderator-coolant submitted to radiations can be restored and stabilized in replacing the losses of terphenyl by equal amounts of an aromatic hydrocarbon such as xylene, cumene, or toluene, lighter and more volatile than diphenyl. Their lower specific gravity compensates the thickening of the terphenyl due to polymerization. (EURATOM)

16670 CONTROL DEVICE FOR BOILING WATER REACTOR. C. Samuel (to Societe Indatom). Belgian Patent 585,250. Dec. 31, 1959. (In French)

The device comprises, as usual, an ionization chamber, an amplifier with negative feedback, and a derivative network; these feed into one input of a differential amplifier, the second input of which is a signal proportional to the position of the control rods. The output of the differential amplifier is fed into a servomechanism which actuates the

control rods. It is claimed that, even at full power, oscillations are of very low amplitude and duration. (EURATOM)

16671 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Benjamin N. Furber (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 861,868. Mar. 1, 1961.

A reactor fuel element configuration for heterogeneous reactors is designed which provides both high nuclear efficiency and a high heat transfer to the coolant. The element comprises a plurality of hollow cylinders of canned fissile material arranged concentrically one within the other, interlocking fins being formed in the spaces between the cylinders. Coolant is passed into the spaces between the cylinders to accomplish the heat transfer. (D.L.C.)

16672 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Peter John Grant (to General Electric Co., Ltd.). British Patent 861,975. Mar. 1, 1961.

A control rod apparatus is designed for correcting neutron flux distortion in reactors whose fuel is associated with the moderator, e.g., fuel elements inserted in a moderating core. The control rods, either one or two in number, are constructed and controlled so that movement of neutron-absorbing material into one end of the core is followed by movement of neutron-absorbing material out of the other end, keeping the total flux constant while correcting the flux in one end. (D.L.C.)

16673 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Clive Frederick George Dupen (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 862,125. Mar. 1, 1961.

A reactor fuel plate assembly element is designed which makes provision for the growth of plates due to nuclear bombardment. The element comprises an outer hollow casing with oblique internal guides which support an array of spaced parallel fuel plate batches with clearance to allow for expansion. (D.L.C.)

16674 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Laurence Hack and Derek Macfall (to United Kingdom Atomic Energy Authority). British Patent 862,324. Mar. 8, 1961.

A mechanical linkage and motor for moving a control member in and out of a reactor are designed which can be used with compact reactors. The motor is of annular construction, and the linkage is of telescopic construction so that it can close into the motor. The linkage incorporates a rack-operated movement amplifier and limit switches to retain the control member in either of two extreme positions. The motor is divided into two motors, one for rapid movement and the other for variable-speed movement of the linkage. (D.L.C.)

16675 THORIUM DISPERSION IN BISMUTH. (to U. S. Atomic Energy Commission). British Patent 865,029. Apr. 12, 1961.

A method is given for preparing stable dispersions of thorium in liquid bismuth suitable for use in reactors as a source of fissionable material and as a coolant. In this method, a small amount of tellurium is incorporated in the dispersions to inhibit particle growth and deposition (due to formation of $ThBi_2$) and corrosion of alloys of Fe, Co, or Ni. Such dispersions should contain 1 to 12 wt.% thorium and a quantity of tellurium amounting to 1 to 5 wt.% of the thorium. Data are presented illustrating the properties of dispersions with and without tellurium under thermal cycling conditions. (D.L.C.)

16676 IMPROVEMENTS IN OR RELATING TO GIRDLES FOR NUCLEAR REACTOR CORES. (to Commissariat a l'Energie Atomique). British Patent 865,286. Apr. 12, 1961.

A girdle is designed for holding in place vertically stacked solid moderator bars (particularly graphite) in a reactor core. The girdle comprises a plurality of links with each link being coupled at its end to the next link and springs to resist outward movement of the links. The girdle link connections are such that in effect two girdles are formed and the girdling of the core is not destroyed if one of the connections is broken. (D.L.C.)

Power Reactors

16677 (APAE-76) FISSION PRODUCT ACTIVITY IN SM-1 CORE I PRIMARY SYSTEM AND SURFACE CONTAMINATION ON SM-1 TYPE FUEL ELEMENTS TASK XVIII-PHASES 2 AND 3. Robert A. Hasse and John L. Zegger (Alco Products, Inc., Schenectady, N. Y.). Feb. 28, 1961. Contract AT(30-3)-326. 59p.

Evidence is presented to indicate that a fuel element defect was responsible for the high fission-product activity level observed in the primary coolant. Relative escape coefficients are calculated and the defect size is estimated. Anticipated fission-product levels during SM-1 Core II and SM-1A Core 1 operation are estimated from alpha surface contamination data on completed fuel elements. The importance of in-line sampling for monitoring fission-product activity is stressed as well as the need for detecting fuel element methods. (auth)

16678 (APAE-Memo-281) PWR RESEARCH AND DEVELOPMENT PROGRAM. TEST REPORT. GAMMA SCANNING SPENT SM-1 CORE I FUEL ELEMENTS. TEST 318. S. N. Kemp, W. J. McCool, and F. G. Moote (Alco Products, Inc., Schenectady, N. Y.). Apr. 6, 1961. Contract AT(30-1)-2639. 110p.

A test was designed and performed to experimentally determine fuel burnup distribution in the SM-1 Core I spent fuel elements. It was believed to be feasible if the spatial distribution of the gamma rays emitted from a long-lived, unsaturated fission product could be measured. However, scintillation spectra indicated an intense peak between 0.7 and 0.8 Mev, primarily attributed to the 63-day Zr^{95} fission product and 35-day Nb^{95}. The magnitude of this peak nullified the possibility of distinguishing a long-lived fission product that could be used for scanning purposes. The stationary elements of one quadrant of the core were scanned using the $Zr^{95}-Nb^{95}$ peak as the energy interval. The results represent a fair approximation of the power distribution in SM-1 Core I during the latter portion of operating history. Results of the experiment are presented with a description of the techniques and test equipment used. (auth)

16679 (CF-61-3-69) EGCR CORE STRUCTURAL ANALYSIS. THE EFFECTS OF FAST-NEUTRON IRRADIATION AND THE BOWING CHARACTERISTICS OF THE GRAPHITE COLUMNS. S. E. Moore and W. A. Shaw (Oak Ridge National Lab., Tenn.). Apr. 14, 1961. 41p.

An analysis of the EGCR core structure was made to determine the lateral deflections (bowing) of the graphite columns resulting from shrinkage caused by fast-neutron irradiation, the life expectancy of each column due to restraints imposed on the bowing, and the reaction forces induced in the supporting structures. Based on currently available data for EGCR type graphite shrinkage and assuming experimental loop operation, a maximum bowing potential of 3.61 in. was calculated for an interior column. It was found that strains equivalent to the rupture strains observed from tensile tests could be expected after 4 to

urs of full-power operation. Over half of the columns reach these strains before the 20-yr reactor design s reached. (auth)

00 (CF-61-3-87) MEASURED CIRCULATION ES IN THE HRT. J. O. Kolb, P. N. Haubenreich, and . Engel (Oak Ridge National Lab., Tenn.). Mar. 20, . 12p.

rculation rates in the fuel and blanket high-pressure ems were calculated from the measured pressure drops oss the heat exchangers. Circulation rates at 260°C e 433 gpm through the core and 256 gpm through the ket. There was little effect of temperature on the volu- ric flow rates between 150 and 280°C. Low-temperature surements in the fuel system indicated higher rates, these were attributed to the replacement of the fuel culating pump between the high-temperature and low- perature measurements. (auth)

81 (CF-61-3-89) ANALYSIS OF HRT BEHAVIOR. l R. Kasten and Melvin L. Tobias (Oak Ridge National ., Tenn.). Mar. 13, 1961. 8p.

Methods are outlined which are presently in use to es- lish a mechanism to account for the fluctuations observed he power trace of the HRT. Examination of large quanti- s of digitized data from the reactor is carried out using nputer codes so that objective interpretation of the reac- 's behavior may be made. In addition to the study of the a from the reactor, the salt-concentration experiments, de in a full scale model of the HRT core, are being uti- ed to test the hypothesis that the power fluctuations ginate from fluctuations in flow patterns. (auth)

82 (CF-61-3-98) A COMPUTATIONAL SURVEY OF ME GRAPHITE-MODERATED MOLTEN SALT REAC- ORS. C. W. Nestor, Jr. (Oak Ridge National Lab., Tenn.). ar. 15, 1961. Contract W-7405-Eng-26. 12p.

The results of a number of reactor physics calculations rformed in connection with the preliminary nuclear design the MSRE are presented. Estimates were made of core itical mass, circulating system inventory, temperature efficient of reactivity associated with salt expansion and her core parameters for cylindrical, graphite-moderated, olten salt reactors having fuel volume fractions from 12 to %; additional calculations were done to determine whether gnificant power flattening or reduction in circulating in- ntory would result from dividing the core into two or three ctions of different fuel volume fraction. In the one-region ases, a shallow minimum was found in the circulating in- ntory at about 18 vol.% fuel; at 12% the computed U-235 ventory was 51 kilograms, at 28% 52 kilograms; the mini- um inventory was 47 kilograms. The calculated tempera- re coefficient of reactivity due to expansion of the fuel lt decreased from -3.9×10^{-5}/°F at 12 vol.% fuel to 2.9×10^{-5}/°F at 28 vol.%; the reactivity introduced by el-salt penetration of the core graphite also decreased, rom 11% δk/k at 12 vol.% fuel to 3.5% δk/k at 28 vol.% fuel. was found that the core critical mass could be reduced in three-region reactor to 9.3 kilograms U-235 by using fuel olume percentages of 25, 6, and 4 in the inner, middle and uter rings, but the associated inventory was found to be 44 ilograms, and the peak-to-average power density ratio was ncreased to 4.0 as compared to 3.1 in a uniform reactor. It as concluded that the improvements obtained were not arge enough to justify the additional complications in the abrication of multi-region cores. (auth)

16683 (DLCS-1470105) DETERMINATION OF REACTOR COOLANT SYSTEM PRESSURE DROP. CORE I, SEED 2. Test Results T-550129. (Duquesne Light Co., Shippingport, Penna.). First issue, Feb. 3, 1961. 26p.

An investigation was conducted to determine the Reactor Coolant System pressure drop and flow behavior. The investigation was one of a series to be performed at intervals during the life of the station. Because of inconsistencies of the observed data, no definite conclusions can be drawn concerning pressure drop. (J.R.D.)

16684 (DLCS-1550106) EXAMINATION OF COMPONENTS FOR CRUD AND CORROSION. CORE I, SEED 2. Test Results T-612080. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 20, 1961. 10p.

An examination was made to observe the extent and location of corrosion, crud deposits, and defects in components of the PWR primary fluid system and its auxiliaries. A gamma spectrum of the four-inch line upstream from the two pressurizer self-actuated relief valves showed the presence of Mn^{54} and Co^{60}. From the gamma spectrum and the gross gamma activity, the Co^{60} was found to be 5.03×10^3 dpm/mg or about 70 per cent of the gross gamma activity. (J.R.D.)

16685 (DLCS-1560110) XENON TRANSIENT TESTS. CORE I, SEED 2. Section 1. Test Results T-612081. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 30, 1961. 36p.

A test was conducted to determine if sufficient excess reactivity exists in the core to override a peak xenon transient, and to obtain data for rod worth calculations. After completion of 224.7 EFPH of plant operation with Core 1, seed 2 (8053.9 EFPH total Core I operation), there was sufficient reactivity to override the peak xenon transient imposed by a rapid station shutdown from an average reactor power level of 105.24%. Data on rod worth and other test results are included. (J.R.D.)

16686 (DLCS-1820102) FLOW DISTRIBUTION ACROSS THE CORE. CORE I, SEED 2. Section 1. Test Results T-550097. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 31, 1961. 13p.

An investigation was conducted to determine flow distribution characteristics within the core and determine any relative shift in flow between the seed and the four blanket regions. The highest average flow measured through the blanket regions, for each loop arrangement, was established, however the flow in other regions was not consistent enough to establish a pattern. (J.R.D.)

16687 (DLCS-1820202) FLOW DISTRIBUTION ACROSS THE CORE. CORE I, SEED 2, Section 2. Test Results T-550097. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 31, 1961. 26p.

An investigation was conducted to determine the reactor coolant mixing characteristics of the inlet plenum chamber. It was found that mixing in the inlet plenum was slight, and flow from a given loop is confined mainly to its quadrant of the core. There appears to be no significant change in the flow rate through the fuel assemblies monitored with the reactor coolant introduced at various temperatures and the reactor coolant pump on either fast or slow speed. (J.R.D.)

16688 (DLCS-1840311) PERIODIC RADIATION SURVEY OF REACTOR PLANT CONTAINER AND COMPONENTS AFTER SHUTDOWN. CORE I, SEED 1. Section 3. Test Results T-612076. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 17, 1961. 8p.

A periodic survey was conducted to determine changes in radiation level in the hairpin loops resulting from continued operation of the reactor at power. Results indicate that Co^{60} was the major contributor to the gamma activity present on the 1 BD Hairpin Loop. Loose scale in this area amounted to 0.104 mg/cm^2. (J.R.D.)

16689 (DLCS-2110132) PERIODIC REACTOR PLANT LEAK RATE TEST. CORE 1, SEED 2. Test Results. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 20, 1961. 9p.

An investigation was made to determine the magnitude and location of the reactor coolant system leakage of the Shippingport Power Reactor. The "total" plant leakage was indicated by the pressurizer level change since no make-up was added during the test. The "accounted for" leakage was indicated by the flash tank level change and the blowoff tank level change. The relief valves from the pressurizer and reactor were checked for leakage individually and a combined leakage of 2.84 gal/hr was obtained for the 6 valves tested. The system was found to have a total leak rate of 5.65 gal/hr of which 1.17 gal/hr was "accounted for." (M.C.G.)

16690 (DLCS-2110135) PERIODIC REACTOR PLANT LEAK RATE TEST. CORE I, SEED 2. Test Results T-641102. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 20, 1961. 13p.

An investigation was conducted to determine the magnitude of reactor coolant leakage through the reactor relief valve and the pressurizer relief valves. The pressurizer relief valve leak rate was not significantly different from that found in the previous performance test. The rate in the reactor relief valve decreased considerably. (J.R.D.)

16691 (DLCS-2110136) PERIODIC PRIMARY PLANT LEAK RATE TEST. CORE I, SEED 2. Test Results T-641102. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 30, 1961. Contract AT(11-1)-292. 13p.

A test was conducted to determine the pressurizer relief valves leak rate prior to, immediately after, and twenty four hours after flushing. The leak rates were found to be relatively constant. (J.R.D.)

16692 (DLCS-2130301) MODIFIED PURIFICATION SYSTEM PERFORMANCE TEST (RESIN SAMPLING). CORE I, SEED 2. Section 3. Test Results T-641124-A. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 24, 1961. Contract AT(11-1)-292. 9p.

A procedure for obtaining samples of resin from a Purification System Demineralizer was unsatisfactory because the material obtained was not representative of the resin throughout the bed. (J.R.D.)

16693 (DLCS-2250105) REACTIVITY LIFETIME 5091.4–5806.1 EFPH. CORE I, SEED 1. Test Results T-612118-B. (Duquesne Light Co., Shippingport, Penna.). First issue, Aug. 1, 1960. 146p.

The Shippingport Atomic Power Station was operated for 715 EFPH from Aug. 11 to Oct. 7, 1959, in order to determine the performance characteristics reliability, stability, and lifetime variation of the core during rated power operation for an extended period of time. The plant was operated at successively lower power levels of 60, 43, and 17 Mwe to extend the Core I, Seed 1 lifetime. Logs and tables are included which present the events and all recorded data in this period. (D.L.C.)

16694 (DLCS-2710101) LOAD DUMP TEST. CORE I, SEED 2. Test Results. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 31, 1961. Contract AT(11-1)-292. 27p.

A test was conducted to determine the performance of the auxiliary governor of the turbine-generator unit in instantaneous electrical load losses. The effect of the transient induced by such a loss of load on the Reactor Plant was also of interest. Results indicated proper governor operation, and favorable Reactor Plant response. (J.R.D.)

16695 (DLCS-2760101) CONTROLLED SAFETY TEST ROD WITHDRAWAL TRANSIENTS (DURING START-UP). CORE I, SEED 2. EFPH–8054.1 CORE 1 (TOTAL) 2248.1 SEED 2. Section 1. Test Results T-612393-C. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 31, 1961. Contract AT(11-1)-292. 18p.

Tests were conducted to obtain data on the dynamic response of the Reactor Plant to various startup rod withdrawal transients. Results were compared with those obtained in simulator studies. (auth)

16696 (DLCS-3450103) STATION PERFORMANCE DURING AN UNSCHEDULED POWER TRANSIENT. CORE I, SEED 2. Test Results T-643730. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 31, 1961. Contract AT(11-1)-292. 7p.

Observations were made to correlate information on station performance during an unscheduled power transient. A turbine throttle trip occurred with the station at a gross electrical load of 67 Mw. No safety shutdown occurred and the station was returned to power in 36 minutes. (J.R.D.)

16697 (DLCS-3490101) STATION PERFORMANCE AT STEADY STATE LOADS. Test Results (T-643728). Core Seed 2. (Duquesne Light Co., Shippingport, Penna.). First issue, Feb. 3, 1961. 167p.

An investigation was conducted to determine core thermal output, power distribution in the core, boiler performance, main unit heat rate, and linearity of the nuclear signal with core output at various loads on the main unit. A power level of 99.5% was determined, and the core power distribution was found to be uniform. The heat transfer coefficient was within design tolerances. The plot of the nuclear signals and calorimetrics was linear. (J.R.D.)

16698 (DLCS-3500202) FEDAL SYSTEM OPERATION DURING STATION START-UP. Test Results (T-643734). Core I, Seed 2. Section I. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 31, 1961. 13p.

An investigation was conducted to determine if any failed blanket fuel elements exist in core locations previously found to have high levels of delayed neutron emitter activity. Data from Fedal System monitors indicate that J5 may have a failed blanket element, there is no evidence of failure at core location F7. (J.R.D.)

16699 (DLCS-3540101) DETERMINATION OF RADIONUCLIDE BASE LEVELS. Test Results (T-641106-A). Core I, Seed 2. EFPH-65.2 and 89.9. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 30, 1961. 16p.

An investigation was conducted to establish the specific activity of various radioactive nuclides in the coolant during power operation for use in determining fuel element failures or contamination. Coolant specific activities were determined at 65.2 EFPH and 89.9 EFPH after power runs. From data gathered in these observations, base level activities were established. (J.R.D.)

16700 (DLCS-3750101) RADIATION SURVEY OF IRRADIATED CORE I SEED 1 COMPONENTS. Test Results. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 20, 1961. 17p.

A test was conducted to determine the radiation levels in the air near irradiated core 1 seed 1 components. Survey results indicate that all components can be shipped to a burial site with shielding material and containers provided at Shippingport. (J.R.D.)

16701 (DP-570) ECONOMIC POTENTIAL FOR D_2O POWER REACTORS. Lawrence Isakoff (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). Feb. 1961. Contract AT(07-2)-1. 76p.

Economic evaluations indicate that heavy-water-cooled-d-moderated power reactors could become competitive th modern fossil-fueled stations when the capacity of ch is about 300 Mwe. Heavy water reactors may attain is position without requiring low-cost spent fuel re-rocessing or large credits for recovered uranium and utonium. In these evaluations of D_2O reactors, spent fuel as assumed to be of no value and to be stored indefinitely. he key to the achievement of competitive energy costs om heavy water reactors is successful completion of the rrent program to develop natural uranium fuel elements low fabrication cost. Other features that favor the vig-rous development of heavy water reactors are their good eutron economy and the ready availability of natural ranium. (auth)

16702 (GAMD-884) ACTIVATION OF THE HEAT EX-HANGER OF THE HTGR DUE TO NEUTRON STREAMING. . W. Nordheim (General Atomic Div., General Dynamics orp., San Diego, Calif.). July 20, 1959. 9p.

A calculation is made of the activation of the heat exhanger from neutron streaming in the gas duct from the eactor. It is shown that the effect is small enough so as ot to prevent the possibility of breaking connections in hort times and then handling the heat exchanger by a rane. (D.L.C.)

16703 (GAMD-1139) HTGR CARBON TRANSPORT AS A FUNCTION OF THE PURIFICATION FLOW RATE AND STEAM INLEAKAGE. R. J. Mulvihill (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Dec. 15, 959. Contract AT(04-3)-314. 11p.

A new determination was made of the relationship beween the total oxygen impurity level in helium and the ate of carbon transport from the HTGR core. This estiate was based on the mass transfer of carbon monoxide o the boiler superheater metal surface as being the conrolling rate process. The relationship between a continuous steam leakage rate into the helium through the boiler and the helium purity as a function of the purification flow was also determined. It was found that a purification flow rate of 200 lb/hr plus a fission product trapping system flow rate of 200 lb/hr with an effluent purity of 1.5 ppm will maintain the helium purity at 7 ppm for a steam leakage rate of 0.010 lb/hr. The carbon transport from the core to the active portion of the core was found to be such that it will result in the removal of less than 1.26 mils of graphite per year. (auth)

16704 (GAMD-1206 and Suppl.) HTGR STEAM GENERATOR PART LOAD PERFORMANCE WITH GRAPHITE CLAD REACTOR FUEL ELEMENTS. N. W. Richards (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Jan. 21, 1960. 19p. Contract AT(04-3)-314. Project No. 32.

An IBM-704 machine program is presented for calculating part-load performance of the HTGR steam generators. (W.L.H.)

16705 (GEAP-3290) NUCLEAR SUPERHEAT PROJECT FIRST QUARTERLY PROGRESS REPORT JULY–SEPTEMBER 1959. R. T. Pennington (General Electric Co., Atomic Power Equipment Dept., San Jose, Calif.). Dec. 1, 1959. 127p. Contract AT(04-3)-189, Project Agreement No. 13.

Activities are reported in a program which emphasizes nuclear superheat fuel development and coolant chemistry evaluations utilizing the Superheat Advanced Demonstration Experiment (SADE) as the basic engineering development tool. The development activity is restricted to consideration of light water moderated reactor types using low enrichment ceramic UO_2 fuel. The design of the SADE loop is described. It provides a fully instrumented flexible test facility that is introduced into the Vallecitos Boiling Water Reactor (VBWR) through a refueling port. Progress is reported in selection of preliminary reference design conditions and establishment of a design philosophy for the Superheat Reactor. Advantages of the bayonet fuel configuration are discussed along with those associated with the bayonet tube bundle concept. Most of the physics effort during the period was devoted to development of calculational tools for study of specific types of superheat fuel elements, and preliminary analysis of power distributions in integral superheat reactors. The nuclear analysis of various superheat and boiling water lattices is being carried out using a three-group diffusion theory with fission restricted to the thermal group. In a study of power distributions in superheat reactors it was found that the specific power of a fuel element is essentially proportional to the product of thermal flux in the fuel, and fuel enrichment, thus posing the question of optimum fuel location. A summary of system parameters is included. In fuel technology, a summary is given of post-irradiation observations of the first superheat fuel element irradiated in the SADE loop of VBWR. In out-of-pile cladding pressure tests, empty tubing and tubes loaded with simulated fuel in which the gap clearance was varied were subjected to pressure collapse tests. Plans for further fuel testing in SADE are given. Several fuel concepts are discussed with the emphasis on the SH-4 concept. A discussion of the combination boiling-superheat fuel concept is also included. In materials development, type 304 stainless steel was selected as the reference cladding material with 316 stainless steel the alternate. Data from radiochemical and coolant chemistry evaluations are summarized. Results are given of a radiation heat transfer experiment employing low vacuum nitrogen and nitrogen at 415 psia, and helium at 14.7 to 255 psia. Parametric studies and calculations were conducted for a high-quality test section to determine a feasible type with design dimensions which will result in optimum range of test variables within the limits of the existing facility. (J.R.D.)

16706 (GEAP-3468) NUCLEAR SUPERHEAT PROJECT THIRD QUARTERLY PROGRESS REPORT, JANUARY–MARCH, 1960. R. T. Pennington (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). July 1, 1960. 198p. Contract AT(04-3)-189, Project Agreement 13.

A summary of significant results by task is presented. Task A–Conceptual Design and Program Evaluation. Reactor design studies were directed toward continuation of economic evaluations of alternate fuel types and core arrangements. Results indicate that the realization of the potential of reduced power cost from the superheat concept are dependent on achievement of neutron economy comparable to boiling water reactors by reducing the stainless steel in the core and reducing moderator to fuel ratios, increasing power density in the superheated steam cooled region of the reactor, and utilization of the superheat reactor in relatively large nuclear power plants. Economic optimization study results indicated that the rod-type, low-enrichment ceramic UO_2 fuel for superheat application has about the same economic potential as the annular fuel concept. The annular fuel concept will be retained as the reference design superheat fuel concept because of expected lower fabrication costs and apparent advantages in reactor mechanical design. Nuclear physics studies were completed to evaluate the significance of reactivity changes due to flooding of the steam passages in an annular fuel

element. Results indicate that there will be a significant economic penalty if the moderator-to-fuel ratio is selected large enough to obtain a fuel lattice with a negative boiling coefficient and a small flooding coefficient. For stainless-steel-to-fuel ratios above 0.3, the penalty for high moderator to fuel ratio is small; but for stainless-steel-to-fuel ratios of 0.2, the fuel cost difference between moderator-to-fuel ratios of 2.6 and 2.0 may be as high as 0.1 mil/kw hr. Preliminary results are reported on the power plant characteristics for a 300-Mw(e) boiling water separate superheat power plant. Start-up, shut-down and control systems for a separate nuclear superheat plant are discussed. Task B–Fuel Technology. The results of post-irradiation investigations on the first two SADE (Superheat Advance Demonstration Experiment) superheat fuel elements are reported in detail. It was found that the maximum capability of UO_2 in these exploratory experiments was not utilized indicating the desirability of increasing specific power in the annular fuel configuration. It was also found that oxidation rates in reactor superheated steam are comparable to non-nuclear environment, that hairline cracks found in the type 347 Stainless Steel cladding after irradiation indicate the necessity of careful non-destructive testing of as-received stainless tubing, and that flux traverses at inert spacers in the fuel element indicate relatively low (about 11%) axial flux peaking. The design of equipment and planning for the Trail Cable Capsule irradiation facility continued. The first GETR capsule with swaged over pellets was irradiated in GETR reactor. Out-of-pile, pressure collapse tests for thin stainless cladding were continued. Task C–Material Development. Specimens for tensile pull tests were prepared from the SH-2 fuel element. Task D–Experimental Physics. The design for the superheat fuel element for the critical experiment was completed. Specification for fuel and other required material was released for procurement. Task E–Corrosion and Coolant Chemistry. The modifications to the existing boiling water corrosion loop for superheated steam corrosion testing were completed. Additional measurements of activity levels from SADE loop are reported. Task F–Heat Transfer. The installation of the test equipment for the once-through heat transfer experiment was completed. Task G–Mechanical Development. The open end two-arc steam separator was tested at the Moss Landing steam separator test facility. The separator exhibited good performance on carryover and carryunder at 1000 psi, 150,000 lbs/hr at 4% to 8% by weight inlet quality. Results of mechanical seal development work are reported. At 1000 psi, 545°F with 50 psi differential, "swage-type" and "butt-type" zirconium-stainless steel couplings and 2.5-inch and 4.0-inch "Marmon Conoseal" clamps were found to have low leakage rates. (auth)

16707 (IDO-16570) EXPERIMENTAL ORGANIC COOLED REACTOR CONCEPTUAL DESIGN. W. E. Nyer and J. H. Rainwater (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Dec. 1, 1959. Contract AT(10-1)-205. 242p.

The conceptual design for an Experimental Organic-Cooled Reactor which will provide a flexible facility for experimentation to speed the advancement of the organic-cooled power reactor toward its goal of economic nuclear power was prepared. Basically, this goal called for a facility capable of irradiating simultaneously a number of different types of fuel structures and moderators under environmental conditions approximating or exceeding those in organic power reactors. These requirements were satisfied by an organic-cooled and -moderated reactor designed for operation at 40 Mw at 500°F inlet temperature. This reactor, as designed, could also be operated at 20 Mw and 700°F or intermediate conditions to provide desired test environments for the program. Plate-type fuel elements with stainless steel cladding over a UO_2-stainless steel alloy will be used. The reactor will operate at a pressure of 150 psi and a flow rate of 25,000 gpm. The system is designed to operate at pressures up to 300 psig and temperatures as high as 850°F. The reactor tank, thermal shields and biological shielding are designed for power levels up to 220 Mw. The design incorporates provision for installation of several experimental loops up to 7.5 in. in diameter. Of these, two loops about 6.5 in. in diameter and three loops 2.5 in. in diameter are recommended as part of initial construction. The core lattice spacing is such that driver (stainless steel) elements can be replaced by large-cross-section power reactor elements for experimental purposes. Fuel and coolant studies can also be carried out in larger scale by utilizing the entire core and coolant system. Removable grids and tank internals will permit core rearrangement for testing any core array not accommodated by the original grids. The estimated cost for the reactor constructed at the National Reactor Testing Station (excluding loops) is $6,310,000 and the operating costs, not including the experimental program, are $1,510,000 annually for a staff of 59. The estimated cost of one 6.5-in. OD loop is $484,000, and the total cost of the five loops which constitutes the recommended initial installation of experimental facilities is $1,800,000. The general needs of the organic program and the principal design features of the EOCR are discussed. The research program and design objectives are given in detail. The EOCR design, supporting information, and design details are presented. (auth)

16708 (IDO-28567) ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. Semiannual Progress Report July 1–December 31, 1960. (Aerojet-General Nucleonics, San Ramon, Calif.). Feb. 22, 1961. Contract AT(10-1)-880. 210p.

Significant highlights are presented of the work performed during the last six months of the calendar year 1960 in connection with the Army Gas-Cooled Reactor Experiment, the ML-1 (a prototype mobile gas-cooled nuclear power plant), the Advanced Systems Project, and the Gas Turbine Test Facility. The status and progress of each project are reported as is information on associated tests and data evaluation, and the status of fabrication of experimental and prototype components. (auth)

16709 (MND-M3A-2449) PM-3A NUCLEAR POWER PLANT PROGRAM SECOND QUARTERLY PROGRESS REPORT, NOVEMBER 16, 1960 TO FEBRUARY 15, 1961. (Martin Co. Nuclear Div., Baltimore). Apr. 2, 1961. Contract AT(30-1)-2700. 69p.

Information is presented on the design, fabrication, testing, shipment, installation, site testing and trial operation of a prepackaged, air-transportable, pressurized water reactor nuclear power plant, the PM-3A. The specified output is 1500 kw. The plant is to be operational by March 1962. (B.O.G.)

16710 (MND-M-1914) PM-1 NUCLEAR POWER PLANT PROGRAM CONTROLS AND INSTRUMENTATION REPORT. (Martin Co. Nuclear Div., Baltimore). Feb. 1960. 180p. Contract AT(30-1)2345.

A reliability analysis designed to obtain a statistical figure of merit on the operation of the primary loop controls and the instrumentation system is outlined. The analysis will provide information which will aid in maintenance

anning, stock inventory of replacement parts, and the stablishment of a quality control program. (W.L.H.)

5711 (MND-P-3013-II) SNAP PROGRAMS. Quarrly Progress Report No. 5, October 1—December 31, 1960. Martin Co. Nuclear Div., Baltimore). Contract AT(30-3)-17. 138p.

The procedure for fueling a thermionic generator with m^{242} heat source was evaluated. Aspects stressed in development of generator 2B include generator ability to withtand statement of work specified dynamic loads, interelecode spacing reduction, collector work function reduction, nd heat loss reduction. A collector work function of 2.0 olts was achieved at 900°K in an activation test unit built o observe heat transfer between heater and emitter. Fuel echnology development was centered around Cm^{242} and Pu^{238}. J.R.D.)

16712 (NAA-SR-5991) PRELIMINARY RESULTS OF THE SNAP 2 EXPERIMENTAL REACTOR. M. W. Hulin and J. Beall, eds. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 1, 1961. Contract AT(11-1)-GEN-8. 60p.

The operating history of the SNAP 2 Experimental Reactor (SER) and the preliminary results from the testing program are presented. The total energy generated during the life of the reactor was 224,650 kilowatt hours. This is equivalent to approximately one-half year of full-power operation. The methods used to obtain the reactor parameters are also described. The experimental data obtained were generally in excellent agreement with calculated values. The principal comparisons are tabulated. (auth)

16713 (NDA-2116-9) SPONGE FUEL EVALUATION. Quarterly Technical Report for period Ending December 31, 1960. J. M. McKee (Nuclear Development Associates, Inc., White Plains, N. Y.). Feb. 28, 1961. Contract AT(30-1)-2303. 12p.

In the program of evaluation of sponge fuel (uranium powder vibrated to maximum density in a container tube and infiltrated with sodium), the irradiation of capsule NDA 4-2 was completed at 0.88% burnup of all uranium atoms and the capsule was replaced in the reactor by capsule NDA 4-3. The thermal conductivity of capsule 4-3 was measured and found to be identical with that of 4-2. The irradiation and temperature history of capsule 4-3 and the fabrication of capsule 4-4 are discussed. (D.L.C.)

16714 (NDA-2147-4) REVIEW OF INVESTIGATIONS PERTINENT TO THE PREDICTION OF THE THERMAL BEHAVIOR OF FAST REACTORS UNDER ABNORMAL OPERATING CONDITIONS. F. E. Beers (Nuclear Development Associates, Inc., White Plains, N. Y.). Mar. 15, 1961. Contract AT(30-1)2303. 41p.

Results are summarized for a survey of methods for predicting fuel element and coolant behavior in sodium-cooled fast reactors under abnormal operating conditions. Circumstances prior to, during, and after meltdown are considered, and the behavior of fuel and coolant during transients is discussed. Reactor excursions, theory of fuel element thermal transients, reactor coolant transients in single and two-phase flows, and specific topics such as two-phase flow patterns, two-phase pressure drop, and transient voids in boiling coolant reactors are also treated. Some applicable mathematical treatments are given along with an annotated bibliography. (D.L.C.)

16715 (ORNL-3014) MOLTEN-SALT REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1960. H. G. MacPherson (Oak Ridge National Lab., Tenn.). Dec. 22, 1960. Contract W-7405-eng-26. 102p.

Conceptual designs of the MSRE were made in which the core is constructed of vertical graphite stringers in which fuel passages are machined. A facility for thermally cycling freeze flanges between room temperature and 1400°F was designed, and fabrication is nearing completion. Two freeze valves, which have no moving parts, are being fabricated for test; one of these is heated by electrical resistance heaters, the second is heated by a high-frequency induction coil. Operation of forced-circulation corrosion loops continued. Nine INOR-8 loops and two Inconel loops are in operation. Design and testing work on the MSRE primary and secondary pumps continued. The testing of in-salt bearings was continued. Graphite undergoes shrinkage at MSRE temperatures in a flux of neutrons with energies greater than 0.3 Mev. Calculations were made to determine the effects of this shrinkage in the MSRE core. An analysis was made of temperature effects in a graphite-moderated core with round and flat fuel channels. An analog-computer analysis was made of loss-of-flow in the MSRE primary system. The last of three INOR-8 corrosion inserts was removed after 15000 hr from an INOR-8 forced-convection loop. Two types of solidified metal seals were developed for use with molten fluorides at elevated temperatures; one contained an alloy sump with a tongue-and-groove joint design, the other has an alloy-impregnated metal-fiber compact. A method was devised and equipment was built for leak testing graphite-to-metal braze joints. Welding and back-brazing procedures are being developed for tube-to-tube sheet joints for the MSRE heat exchanger. Tensile tests were performed to determine the effect of low creep strains on the strength and ductility of INOR-8. Permeation tests were made with S-4 and AGOT graphite using $LiF-BeF_2-ThF_4-UF_4$ at 1300°F at pressures of 25, 65, and 150 psig in 100-hr exposures. Additional tests were made in order to confirm data indicating that the thermal decomposition of $NH_4F \cdot HF$ removes oxygen contamination from graphite to such an extent that it could contain molten $LiF-BeF_2-UF_4$ at 1300°F without causing the usual UO_2 precipitation from the fuel. No carburization was detected on unstressed INOR-8 specimens after exposure to a $LiF-BeF_2-UF_4$—graphite system for 12000 hr at 1300°F. The surface tensions of two $NaF-BeF_2$ mixtures were determined to fall between 200 and 150 dynes/cm over the temperature range 500 to 800°C. Heat transfer studies with $LiF-BeF_2-UF_4-ThF_4$ in Inconel and INOR-8 tubes are reported. Preliminary studies indicated that ThF_4 in molten-salt reactor fuel may be decontaminated from rare-earth fission products by dissolution of the rare-earth fluorides in SbF_5-HF. (For preceding period see ORNL-2973.) (W.L.H.)

16716 (SRO-42) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, FEBRUARY 1961. (Savannah River Operations Office, AEC). 17p.

Research and development activities being carried out by du Pont, Nuclear Metals, Inc., Nuclear Development Corporation of America, Inc., and Sargent and Lundy are summarized. Design and construction progress on the Heavy Water Components Test Reactor is reported. The current status of tasks under the ECNG/FWCNG research and development program is outlined. The Carolinas-Virginia Nuclear Power Associates work on the Power Demonstration Program is reviewed. (M.C.G.)

16717 (SRO-43) HEAVY WATER POWER REACTOR PROGRAM. Monthly Progress Report, March 1961. (Savannah River Operations Office, AEC). 21p.

Research and Development. A four-tube machine was proposed for use as the CANDU refueling machine. The ball valve appears to be satisfactory for use in the adapter

valve assembly for closure of pressure tube and fittings during charging and discharging operations. Operation and performance are reported for Task X loop run. In investigations of the cause of failure of vibratory-compacted and swaged UO_2 tubes clad with Zircaloy-2, hydride formation was detected on the inside surface of an inner sheath of an unfailed tube. The total and partial void coefficients of reactivity associated with removal of coolant from the PLATR 37-rod UO_2 clusters were measured. Test results on the effect of in-pile local boiling on surface deposition of Zircaloy-2 clad fuel specimens indicate a linear relationship, independent of the heat transfer mode, between crud deposition and thermal neutron flux. Heavy Water Components Test Reactor. Tests of the refurbished prototype control-rod-drive assemblies at SRP gave satisfactory performance. The current status of the reactor and proposed modifications and testing are reviewed. Power Demonstration Program. Improved CVTR plant performance (conversion ratio and heat channel factors) can be obtained by reducing pressure tube and clad thicknesses. A new pressure tube wall thickness was established based on Reference Design II criteria, higher material properties, and different design temperatures and pressures. Preliminary tests on a modified three-baffle assembly indicate a heat leakage ~15% higher than from the Phase II studies, which is ascribed to non-concentric and imperfect baffles. Three series of Phase II heat leakage tests showed that the ball joint gave effective sealing. Since $Q/\Delta T$ was found to vary linearly with the coolant temperature, the use of an average coolant temperature to calculate heat transferred from coolant to moderator is valid. To minimize heat losses, the moderator level must be kept below the top of the gas shroud. Effective mixing flow rates were measured for various fuel rod wrapping configurations. The contact resistance between UO_2 and Zircaloy-2 was determined for various heat fluxes. Irradiation samples revealed two different types of columnar grains in UO_2. The control rod drive mechanism was modified to increase the lifting torque and to reduce control rod flutter. Measurements of the coolant void coefficient were made in process tubes at the center and edge of the core using degraded D_2O. Other reactor measurements were also made, particularly neutron flux distributions. The current status of tasks under the ECNG/FWCNG program is reviewed. (D.L.C.)

16718 (TID-6882) EVALUATION OF THE ORGANIC FOULING PROBLEM IN THE OMRE. (Division of Reactor Development. Civilian Reactors Evaluation and Planning Branch, AEC). Mar. 24, 1961. 36p.

The Organic Moderated Reactor Experiment (OMRE) operating history was reviewed and its fuel elements were examined in order to evaluate the fuel element fouling problem. Particulate matter consisting of $Fe_{20}C_9$ nuclei coated by polymerized organic material was found in the coolant after OMRE operation, and films on the fuel elements were found to contain $Fe_{20}C_9$ and a C/H ratio of 2. On the other hand, the Al-clad element HB-2 from core 2 had a satisfactory appearance, showing that this element type is less subject to fouling than the fully enriched, stainless steel-clad elements. It is concluded that rust forms in the coolant when the reactor system is opened to air and moisture and that films are formed on the fuel elements by disposition of the particulates from the coolant due to electrostatic effects caused by beta decay. Operating procedures for the OMRE are outlined to minimize particulate formation in the coolant and the results are extrapolated to other organic reactors. (D.L.C.)

16719 (TID-7592(p.1-6)) LIQUID FLUIDIZED-BED REACTOR. M. Scheve (Martin Co., Baltimore).

A preliminary study is reported on the liquid fluidized-bed reactor. The following types of fluidized beds were investigated: a gas fluidized bed with a gas fluidizing medium, such as helium; a metal fluidized bed with sodium as the fluid; a D_2O system; and light-water and organic systems. (W.L.H.)

16720 (TID-7592(p.7-11)) PEBBLE-BED REACTOR. R. Benenati (Sanderson and Porter, New York).

The engineering design of a pebble-bed reactor is reported. The structure is graphite and contains seven holes, each about 20 ball diameters across (the ball diameter is 1.5 in). These holes are filled with fuel elements, balls of graphite-uranium oxide mixtures, and the region between this structure and the shell is filled with graphite–thorium oxide balls. Helium gas is the coolant. (W.L.H.)

16721 (TID-7592(p.12)) PROCESS-HEAT REACTOR. J. McGee (Bureau of Mines, Washington, D. C.).

A project (PHR) based on the application of nuclear fission to supply heat for the endothermic reaction of steam with coal was undertaken. The PHR program has two major objectives: (1) development of nuclear reactors capable of heating gases up to 2000 to 2500°F and (2) construction of heat exchangers to transfer this heat to process streams in the same temperature range. The project is discussed. (W.L.H.)

16722 (TID-7592(p.34-43)) GAS-SUSPENSION COOLANTS FOR POWER REACTORS. E. E. Walsh, G. K. Rhode, D. M. Roberts, and D. C. Schluderberg (Babcock and Wilcox Co., Lynchburg, Va.).

A gas-suspension reactor coolant consists of fine particles of graphite suspended in N_2 He, CO_2, Ne, or Ar. A simplified flow diagram of a gas-suspension heat-transfer test loop is given. The loop was operated successfully for more than 300 hr, of which about 70% was at high temperature. No serious operational or materials compatibility problems were encountered. (W.L.H.)

16723 (TID-7598) PROCEEDINGS OF THE POWER REACTOR IN-CORE INSTRUMENTATION MEETING, WASHINGTON, D. C., APRIL 28-29, 1960. (Division of Reactor Development, AEC). Mar. 1961. 20p.

Six reports and discussions given at the Power Reactor In-Core Instrumentation Meeting are given. All six are covered by separate abstracts. (M.C.G.)

16724 (TID-7598(p.1-36)) IN-CORE INSTRUMENTATION FOR WATER-COOLED REACTORS. PART I. G. W. Hardigg (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Current development programs for in-core instrumentation for water-cooled reactors are reviewed. Instrumentation was incorporated in cores to verify core performance prediction with regard to power generation and heat removal, to monitor for fuel element failure, and to determine the potential of various types of instruments of use in cores. A core thermocouple which is removable and replaceable from outside the pressure boundary is described. Fast neutron spectrometry by the foil activation technique was developed using a modified trice method for measurement. Differential foil techniques for measuring thermal flux spectra in water were investigated. Wire activation techniques, gamma ion chambers, a low energy gamma monitor, temperature resistance thermometers, Venturi tubes, and other types of instrumentation are described. (M.C.G.)

16725 (TID-7598(p.37-64)) IN-CORE INSTRUMENTATION FOR WATER-COOLED REACTORS. PART II. J. W.

Green (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Additional developments in in-core instrumentation for water-cooled reactors are outlined. Included in the studies are instruments to determine neutron and gamma flux, heat transfer characteristics, and two-phase fluid flow under both static and dynamic reactor operation. An electro-mechanical computer that would calculate the void fraction from two velocity measurements is described. Modifications of turbine-type flowmeters for in-core application are discussed. Coincident gamma spectrometry of water samples was investigated as a means of detecting short-lived gaseous fission products. The use of in-core instrumentation in calibration of other instruments is discussed. (M.C.G.)

16726 (TID-7598(p.65-76)) IN-CORE INSTRUMENTATION FOR ORGANIC-COOLED REACTORS. D. W. Staub (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.).

A review is presented of in-core instrumentation for organic-cooled reactors. Chromel-alumel thermocouples were used to monitor outlet coolant temperature and cladding surface temperature for the OMRE. Research is in progress on an impact type of flowmeter which would use a differential transformer and would be well balanced by applying pneumatic pressure from an outside source. The core power mapping and control rod programming system proposed as part of the design study for a large, 300-Mw(e), organic-cooled reactor is described. For this system the in-core measurements would be made by using either activation or burnup wires, neutron sensitive thermopiles, or fission ionization chambers. (M.C.G.)

16727 (TID-7598(p.77-82)) IN-CORE INSTRUMENTATION FOR LIQUID-METAL-COOLED REACTORS. D. W. Staub (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.).

Instrumentation in liquid-metal-cooled reactors is discussed. In-core measurements of flux in the SRE are made only at startup. Chromel-alumel stainless-steel sheathed thermocouples were calibrated and tested to fluxes of 10^{21} neutrons/cm^2. The influence of the temperature profile on the magnitude of the contamination effect in platinum-rhodium couples is being investigated. A low flux, low temperature system for use in flux monitoring at temperatures below 700°F is being developed. (M.C.G.)

16728 (TID-7598(p.83-108)) IN-CORE INSTRUMENTATION FOR GAS-COOLED REACTORS. C. S. Walker (Oak Ridge National Lab., Tenn.).

The following in-core instrumentation problems in the EGCR are discussed: keeping the gas which circulates through the core, steam generators, and blowers clean; outlet temperature measurement of the gas from each of 232 channels; the spatial distribution of the flux within the core; and the graphite and structural temperature measurements. A pneumatic temperature monitoring system is described. Various types of thermocouples developed for gas-cooled reactors are also described. The problem of measuring fuel element temperatures is reviewed. (M.C.G.)

16729 (TID-7598(p.109-15)) MISCELLANEOUS IN-CORE INSTRUMENT DEVELOPMENTS. F. C. Legler (Atomic Energy Commission, Washington, D. C.).

A heat balance neutron flux sensor is described. This flux sensing device is applicable to any reactor. Thermocouples for surface temperature measurement, a high-temperature ferrite core transducer for liquid level measurement, and a neutron sensor based on the heat meter principle are also described. Methods of measuring temperatures in an oxide fuel are discussed. (M.C.G.)

16730 (TID-7609) NUCLEAR SUPERHEAT MEETING NO. 3, OCTOBER 13 AND 14, 1960, MILWAUKEE, WISCONSIN. Andrew E. Mravca (Chicago Operations Office, AEC). Nov. 10, 1960. 130p. (COO-262).

The third of a series of AEC-sponsored nuclear superheat meetings is summarized. The meeting is a technical seminar with the emphasis on engineering data that have been developed since the second meeting on April 7 to 8, 1960. Among the reactors discussed are Pathfinder, EBWR, BORAX V, NUSU, and BONUS. Reactors being planned and under construction are also discussed. (D.L.C.)

16731 (TID-8530) EVALUATION AND DESIGN OF HEAVY WATER MODERATED POWER REACTOR PLANTS. (Sargent and Lundy, Chicago). Apr. 28, 1960. Contract AT(30-1)-213. 260p. (SL-1773)

Cost estimates and plant designs are presented for reactors moderated and cooled by D_2O, and operating with either direct or indirect cycle plants. The plant capacities considered range from 70 to 300 Mw(e), and include reactors fueled with natural uranium metal and natural UO_2. Results are included of studies conducted which have either a technological or economic effect on the current status of D_2O reactor plants. (B.O.G.)

16732 (TID-11250) NS SAVANNAH NUCLEAR MERCHANT SHIP DESIGN REVIEW. Summary Report. (Ebasco Services, Inc., New York). June 30, 1960. Contract AT(30-1)-2475. 39p. (ESI-S-1)

Results of a survey covering the safety, adequacy, and reliability of certain design and construction features pertaining to the NS Savannah nuclear power plant and related systems are presented. (auth)

16733 (TID-11369) REACTOR CONTAINMENT DESIGN STUDY. Bimonthly Progress Report, November 1–December 15, 1960. (Sargent and Lundy, Chicago). Dec. 23, 1960. Contract AT(11-1)-938. For Armour Research Foundation. 53p. (SL-1857-1).

An economic and technical feasibility study of reactor containment was made for 44-, 180-, and 300-Mwe reactor plants, using standard and Canadian NPD-2 containment concepts. (D.L.C.)

16734 (WAPD-MRP-88) PRESSURIZED WATER REACTOR (PWR) PROJECT. Technical Progress Report for the Period August 24 to October 23, 1960. Philip N. Ross (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). 109p. Contract AT-11-1-GEN-14.

All drawings of the PWR Core-2 cage assembly, seed and blanket fuel assemblies, and the control rod assembly were approved. A number of analyses and tests, which confirm the adequacy of the mechanical design, were completed. Natural boron carbide–silicon carbide was selected as the burnable poison material for Core-2. The basic design of the heat dissipation system was set. Effort on pressure bonding led to the development of a procedure that avoids abnormal grain growth in localized areas of the cladding. It was also found that pyrolytic carbon deposited on fuel wafers is significantly superior to sprayed graphite in reducing uranium diffusion into the cladding of pressure-bonded oxide plates. Corrosion tests resulted in a preliminary conclusion that weight gains in pressure-bonded oxide plates may be reduced by a post-bonding heat treatment involving rapid cooling from the bonding temperature. Preliminary data indicate good corrosion resistance for ZrO_2–UO_2, the reference fuel material for the seed of Core-2. An improved analytical treatment of long-lived fission product poisons was developed for use in subsequent lifetime calculations. Blanket fuel bundles removed from Core-I after 5800 EFPH show no significant changes

in the dimensions. Thermocouple measurements obtained from Core-I show good agreement with predicted coolant temperature rises and fuel element temperatures. Performance tests on a steam generator indicated that low flow exists in the first downcomer at the inlet end of the heat exchanger. The calibration of high range radiation monitoring instruments was studied. (For preceding period see WAPD-MRP-87.) (W.L.H.)

16735 (WAPD-MRP-90) PRESSURIZED WATER REACTOR (PWR) PROJECT. Technical Progress Report for the Period December 24, 1960–February 23, 1961. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Contract AT(11-1)-GEN-14. 104p.

PWR Core 2. Borated stainless steel was adopted as the burnable poison material, and the size of the poison wafers and boron loading was established. Acceptable blanket oxide plates were fabricated consistently by the isostatic-pressure-bonding technique. A satisfactory method was developed for inspection of fuel elements for bond quality. Fuel assembly sampling rakes were redesigned to permit installing outlet temperature thermocouples in preassembled shrouds and closure head. Metallurgy of Core Materials. In-pile thermal conductivities were measured for UO_2, ZrO_2–34 wt.% UO_2, and ZrO_2–46 wt.% UO_2, and irradiation growths in fuel plates containing these materials were determined. Two pressure-bonded 1 wt.% B^{10}–austenitic stainless steel poison plates after a 60% burnup of the B^{10} atoms showed 3 to 4% thickness increase. Borated stainless steel poison cores coated with chromium plus sprayed graphite contained a void space at the compartment ends equivalent to 0.6% of the total core length, while similar cores coated with chromium alone exhibited no void space. Reactor Physics. A test of a cluster mockup of Core 2 was run in the KAPL PTR facility in which measurements of reactivity, power distributions, peaking factors, and boron capture fractions at 535°F were made. The last eight of ten UO_2 fuel elements removed from the PWR-1 blanket during the Seed 2 refueling were analyzed for U and Pu isotopic content. PWR Core 1. The length of a depleted Seed 1 cluster was measured. The special oxide assembly was modified in order to be comparable to the latest Core 2 design. The applicability of modified Seed 2 physics data to Seed 3 operation was verified, and the effect on core power of operation with two depleted Seed 2 clusters in blanket locations during Seed 3 lifetime was evaluated. Power Plant Support. The PWR-1 Seed 2 life will be extended by operating the plant at reduced average temperature and power. A preferred solution composition was established for dissolving core meltdown products. (D.L.C.)

16736 (WAPD-PWR-TE-101) REACTOR PLANT CONTAINER INTEGRITY TEST AIRLOCKS, DLCS 20601, DLCS 35701. W. A. Rhoades (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Mar. 30, 1961. Contract AT(11-1)-Gen-14. 17p.

Results of a test to determine the status of the reactor plant container air locks are presented. In all performances, the leakage rate exceeded the 0.8 psig/hr allowable when tested in the as-found condition. After completion of maintenance as tabulated in air lock test history the leakage rates were reduced below the upper rate limit. (J.R.D.)

16737 (WAPD-TM-266) OVER-ALL EVALUATION OF BLANKET FUEL REMOVED FROM PWR CORE 1 DURING THE FIRST REFUELING OF THE SEED. F. Schwoerer (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Feb. 1961. Contract AT(11-1)-GEN-14. 20p.

Blanket fuel elements removed from the Shippingport core during the first refueling of the seed were examined to determine the magnitude of operationally induced changes. It was found that the behavior of the fuel elements was essentially as expected. This confirms the adequacy of the methods and data used in design and in the analysis of performance. On the basis of these examinations, it is concluded that the blanket fuel is suitable for further irradiation. (auth)

16738 (YAEC-188) SEMI-ANNUAL PROGRESS REPORT ON YANKEE POWER REACTOR FOR THE PERIOD JULY 1 TO DECEMBER 31, 1960. H. E. Walchli (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Feb. 15, 1961. Contract AT(30-3)-222. 51p. For Yankee Atomic Electric Co. Subcontract No. 1.

The principal progress consisted of: Nuclear calculations required for plant startup operations were completed; A study was made to evaluate fuel depletion and a control rod program was prepared; A review was given to flux peaking resulting from an interchange of control rods; Assistance was provided at the site throughout loading of the core and startup experiment program; A statistical evaluation was given to the effect of mechanical tolerances on engineering hot channel factor; The WCAP-2 Yankee Fuel Specimen Examination was transferred from Knolls Atomic Power Laboratory to the MTR Hot Cells at the National Reactor Testing Station in Idaho; Visual examination of the WCAP-2 capsules was begun; and Visual examination was given to the WCAP-4 in-pile loop specimens. (auth)

16739 (NP-tr-583) ATOMIC ROCKETS. M. Viskova. Translated from Tekh. Molodezhi, 28: 37-8(Jan. 1960). 8p.

Considerations are given for applications of possible nonchemical engine systems, using atomic energy, for rocket propulsion. Calculations indicate that the weight of rockets with nuclear engine systems is approximately one-tenth the weight of conventional chemical rockets, and approximately one-fourth the weight of high-energy chemical rockets. (B.O.G.)

16740 THERMODYNAMIC INVESTIGATION OF A GAS TURBINE CIRCUIT FOR NUCLEAR ENERGY PLANTS BY MEANS OF THE CIRCUIT PROCESS CHARACTERISTIC. W. Fratzscher and P. König (Technische Hochschule, Dresden). Kernenergie, 3: 1148-53(Dec. 1960). (In German)

Winterberg (Atomkernenergie, 4: 2(1959)) has proposed a special gas turbine process which works with an isothermal expansion current and which can be theoretically applicable in reactors. This circuit process is compared with various Joule processes. The investigations were made with the circuit characteristics proposed by Jante. It was possible to make a thermodynamically comprehensive evaluation of the Winterberg process. (tr-auth)

16741 AGR [Advanced Gas-Cooled Reactor]. Nuclear Eng., 6: 151-8(Apr. 1961).

The Windscale Advanced Gas Cooled Reactor (AGR) is described. It is a graphite-moderated, CO_2-cooled, power reactor, which uses oxide fuel. The reactor is expected to be operating at full power by the end of 1961. The physics research reactor (Hero) associated with the AGR is also discussed. (T.F.H.)

16742 CONTROL ROD SYSTEMS FOR AGR. A. D. Wright and K. F. Lebeau (Elliott Bros., Ltd. London). Nuclear Eng., 6: 159-61(Apr. 1961).

The design and development of a control rod mechanism are complicated by operating conditions in the reactor and by the exceptionally high degree of reliability required. The main control and the auto control systems developed for AGR are described. (auth)

16743 DUNGENESS NUCLEAR POWER STATION. Nuclear Power, 6: No. 60, 76-96(Apr. 1961).

The Dungeness Power Reactor is a gas-cooled reactor of the Calder Hall type. The gas inlet temperature of 250°C, in association with a reheat steam cycle and direct steam turbine blower drive, yields a high thermal efficiency with no significant increase in fuel element temperatures. The design of the graphite core, the burst cartridge detection system, gas and steam cycles, and the steam generators are investigated. (T.F.H.)

16744 AXIAL FLUX INSTABILITY IN GAS-COOLED POWER REACTORS. R. I. Vaughan and W. J. Pickering (United Kingdom Atomic Energy Authority). Nuclear Power, 6: No. 60, 97-100(Apr. 1961).

Factors influencing axial flux stability in graphite-moderated gas-cooled power reactors are examined. These factors include the temperature coefficients of reactivity, the ratio of the neutron migration area to the square of the core height, fuel- and moderator-to-coolant temperature drop, coolant temperature rise through the core, and the distribution of the axial flux. (T.F.H.)

16745 IMPROVEMENTS IN NUCLEAR REACTORS FOR STEAM GENERATION. (to Societe Rateau). Belgian Patent 570,011. Priority date, Feb. 5, 1958. (In French)

A series of vertical channels, open at both ends, is fitted on a plate which constitutes the bottom of a cylindrical vessel containing feed water; fuel elements are positioned in the channels. When the reactor is operating, feed water vaporizes, saturated steam gathers above water level, and, owing to pressure build-up, it forces its way down through the channels where it is superheated during its close contact with the fuel elements. Changes in the water level can be used in control reactivity. (EURATOM)

16746 A STEAM POWER INSTALLATION FOR NUCLEAR POWER PLANT WITH GAS-COOLED REACTORS. (to Licentia Patent-Verwaltungs G.m.b.H.). British Patent 861,891. Mar. 1, 1961.

A steam power plant is designed for use with gas-cooled power reactors. In this plant, the turbine is divided into two sections, one high pressure and the other low pressure, the low-pressure turbine being the condensing turbine. The feed water from the condensing turbine is divided into two streams, one of which is brought to a higher pressure than the other. The high-pressure feed water is evaporated and superheated in the heat exchanger and then supplied to the high-pressure turbine, while the low-pressure feed water is evaporated and mixed with the exhaust steam of the high-pressure turbine before superheating and then passing to the low-pressure condensing turbine. Circulation of the reactor coolant is effected by a blower driven by a series turbine with no regulating devices and arranged in the steam plant circuit upstream of the low-pressure turbine; such a turbine works with constant efficiency over its whole load range. (D.L.C.)

16747 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Benjamin N. Furber (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 862,389. Mar. 8, 1961.

A simple method is given for reducing the over-all coolant pressure drop along the fuel channels in gas-cooled reactors while limiting the maximum temperature reached by the fuel elements. The method consists of varying the cross-sectional area of the fuel channels, and in reactors with the moderator built out of blocks, such variations can be easily obtained in stepwise fashion. (D.L.C.)

16748 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR GAS-COOLED NUCLEAR REACTORS. Leslie Mark Wyatt and Douglas English (to United Kingdom Atomic Energy Authority). British Patent 863,335. Mar. 22, 1961.

An improved fuel rod cluster with decreased gas streaming between rods is designed for use in gas-cooled reactors. The cluster comprises a plurality of fuel rods spaced on a parallelogram lattice and provided with helix fins which are formed so that the helices on adjacent rods in the lattice are of opposite hands and just touch each other; a small weld at the point of contact will result in a more rigid fuel element. The cluster is located between a pair of support plates which are provided with spaced holes to allow coolant flow from one cluster to the next. (D.L.C.)

16749 IMPROVEMENTS IN OR RELATING TO REACTORS FOR PERFORMING NUCLEAR FISSION REACTIONS. (to Walther & Cie Aktiengesellschaft). British Patent 864,379. Apr. 6, 1961.

A boiling reactor is designed for improved thermal efficiency of the vapor cycle by superheating. The reactor is arranged for double circulation, whereby saturated vapor is produced at the outer periphery and passed to the interior for superheating. The liquid (usually water) enters from above into an annular chamber between the pressure vessel and an outer duct and flows down the length of the reactor, serving as a reflector. At the bottom, the liquid reaches a second annular chamber between the outer and inner ducts where it is heated by fissile fuel elements. At the top of the chamber, the liquid is again deflected and reaches the inner duct where the vapor is superheated. The vapor temperature and pressure may be raised to 600°C and 300 atms gage by employing ceramic fuel elements in the superheating region. One advantage of this arrangement is that the pressure vessel is exposed only to the temperature of the feed liquid. (D.L.C.)

Research Reactors

16750 (AN-240) OPERA PHASE II. ORDNANCE PULSED EXPERIMENTAL RESEARCH ASSEMBLY. Final Report. (Aerojet-General Nucleonics, San Ramon, Calif.). Sept. 15, 1960. Contract DA-04-200-509-OPD-1037. 92p.

The OPERA final design program was planned and scheduled to provide the necessary experimental information to complete the final design of the reactor at its facility. Measurements were made of the high temperature yield strength of V—10% Mo alloy, the present reference design material for the OPERA core. Results obtained with the HATCHET code included the analysis of a variable loaded core of 30, 50, and 90% U^{235} enrichment in three radial regions. Further work on the use of a source showed that it is very difficult to achieve the required burst rod velocity. Without this high velocity a number of small bursts were obtained. Results indicated that it is not desirable to use a large source. A design for the reactor container and gas circulation system was essentially completed. Specifications for the major components were formulated. A mock-up of the reactor was made during the initial design of the reactor container and gas system and is being used as an active design tool. (auth)

16751 (CF-61-2-81) HFIR BERYLLIUM REFLECTOR PRELIMINARY DESIGN REPORT. Neil Hilvety (Oak Ridge National Lab., Tenn.). Feb. 21, 1961. Contract W-7405-Eng-26. 27p.

The HFIR reflector design criteria were considered and a summary of the reflector design is presented. The reflector type chosen as complying best with the established criteria consists of a 3-in. thick removable beryllium annulus utilizing four concentric cylinders with cooling

water flowing through the annuli between cylinders, and an outer 9-in. thick permanent beryllium annulus with axial circular coolant holes. Reflector support structures and experimental facilities are described and probable beryllium replacement costs are indicated. (auth)

16752 (CF-61-3-82) HFIR POOL CRITERIA. Neil Hilvety, L. A. Haack, and J. R. McWherter (Oak Ridge National Lab., Tenn.). Mar. 16, 1961. 48p.

A summary is presented of the current status of design studies concerning biological shielding and heat removal requirements of the HFIR reactor pool, clean pool, and the critical facility pool. Both normal and emergency operations were considered. Thermal stresses induced in the concrete walls and floor of the pools by internal heat generation and environmental temperature differences are reported. Other miscellaneous pool design information is also included. The purpose of this report is to provide a basis for proceeding with Title II design of the HFIR pool and pool coolant system. (auth)

16753 (INTERNUC-55) STUDIES OF CONTROL, POWER SHAPING, AND BURNOUT BEHAVIOR FOR AETR. T. L. Francis, W. S. Delicate, and A. M. Larson, Jr. (Internuclear Co., Inc., Clayton, Mo.). Apr. 5, 1960. Contract AT(11-1)-688. 107p.

Parametric studies were carried out to optimize the performance and obtain an understanding of the nuclear characteristics of the Advanced Engineering Test Reactor (AETR) design concept. Two-dimensional two-group diffusion theory calculations were performed for the purpose of evaluating the worth of the droppable safety reflector. Removal of the D_2O from the 4-in. thick safety reflector region from the level of the top of the active core to the level of the bottom of the active core with a fully poisoned shim reflector region resulted in a decrease in the multiplication factor from 0.9911 to 0.7515. Removal of the D_2O from the 4-in. thick safety reflector region with a clean D_2O shim reflector resulted in a decrease in the multiplication factor from 1.18 to about 1.04. This indicated that the safety reflector worth decreases as the boron poison is removed from the shim reflector during the core life. An iterative procedure using one-dimensional three-group diffusion theory calculations was performed to determine a graded fuel distribution which produces a flat radial power density. The calculations were terminated when the maximum-to-average power density was reduced to 1.018. Burnup calculations, using the CANDLE one-dimensional, four-group diffusion theory depletion code, were performed for flat and graded fuel cores, each containing 12 kg U^{235} initially. The radial variations in the fuel distributions and the power density distributions during the fuel cycle were determined at several times. The effectiveness of a burnable core poison to supplement the soluble-poison shim control in the reflector was investigated. Using a B^{10} poisoning of 0.075 reduced the initial multiplication factor by 5.9%. By adjusting the fuel loading and optimizing the burnable poison, it appeared that the 19-day fuel cycle is feasible. (M.C.G.)

16754 (KAPL-M-JJS-2) REACTIVITY COEFFICIENTS IN THE UNPOISONED PMA-40 SLAB CORE. PART I. MEASUREMENTS. James J. Schultheis (Knolls Atomic Power Lab., Schenectady, N. Y.). Jan. 9, 1961. Contract W-31-109-eng-52. 50p.

Results of reactivity coefficient and flux distribution measurements in the unpoisoned PMA-40 slab core are described. The PMA-40 core is the first in a series of slab cores to be constructed in the KAPL Plastic Mockup Assembly (PMA) for evaluating analytical techniques and cross-section schemes. In addition to the distributed reactivity coefficients of U^{235}, aluminum, and polyethylene, the spatial variation in the reactivity coefficients along the short 12-in. dimension of the core is presented. The description of the core, measurements, and results presented is complete enough so that calculations can be performed without additional information. (auth)

16755 (NP-9951) PRELIMINARY HAZARDS REPORT. EXHIBIT A. CLASS 104 FACILITY LICENSE APPLICATION WITH EXHIBITS B, C, AND D. Ardath H. Emmons and W. R. Pearce (Missouri. Univ., Columbia). Mar. 1961. 477p.

A preliminary hazards report is presented for the University of Missouri research reactor which is to be built at Columbia, Missouri. The proposed flux-trap reactor will be fueled with highly-enriched uranium and will be cooled and moderated with light water; the reactor is designed for eventual operation at 10Mw(th) with initial operation at 5Mw(th). Site characteristics and safety procedures are reviewed. (C.W.H.)

16756 (NP-9978) SAFEGUARDS REPORT FOR THE NORTHROP PULSE RADIATION FACILITY. Earl Feinauer and Robert D. Thomas (Norair. Div. of Northrop Corp., Hawthorne, Calif.). Mar. 22, 1961. 186p. (NB-61-69).

A description is given of the Northrop Pulse Radiation Facility, (NPRF), which consists of a TRIGA Mark-F reactor and associated supporting equipment. The NPRF was designed to operate in the following modes: Mode I—100 kw steady-state operation; Mode II—Pulsed operation up to a maximum transient giving a maximum measured fuel element temperature of 470°C, which corresponds to an energy release of about 18 Mw-sec (approximately 1.9% $\delta K/K$). The movable reactor will be operated in three general areas in the pool: adjacent to the exposure room; adjacent to the beam ports; or at intermediate positions. Based on the analyses presented and operating experience with the prototype TRIGA Mark F and other TRIGA reactors, it is concluded that operation of the NPRF does not present any undue hazard to the health and safety of the operating personnel or the public. (auth)

16757 (NP-10017) SURVEY OF REACTOR FACILITIES FOR RADIATION BIOLOGY RESEARCH. Final Report. Musa Halev (Franklin Inst. Labs. for Research and Development, Philadelphia). May 2, 1958. 185p. (F-A2046).

A comprehensive survey of unclassified literature was made regarding the application of nuclear reactors to biological research. The properties of reactor radiation are summarized. Principal attention is directed to techniques for modifying this radiation for biological experiments. The relative advantages of reactors as compared with other radiation sources are recapitulated. Safety, the effects of experiments on reactivity, and other reactor operating problems are discussed, as also are the costs and operating expenses of various types of installations. Reactor experimental facilities are described, with particular emphasis on biological experimental irradiation facilities. All known reactors being constructed or planned primarily for medical purposes are described. Appendices include a very extensive bibliography and a survey questionnaire, "Radiation Biology Research", previously issued as a separate document. In the survey, nearly all laboratories having experience in the field of radiation biology research replied to questions relating mainly to the application of nuclear radiation in their own researches. (auth)

16758 LEAK TESTS OF THE VESSEL FOR THE JEN-1 EXPERIMENTAL REACTOR. María Alicia Crespí.

nergia nuclear (Madrid), 4: No. 16, 61-9(Oct.-Dec. 1960). n Spanish)

The air-tightness of the vessel of the JEN-1 Reactor was e-examined. First, a comparative study was made of re- tor building and vessels, and their requirements for air- ghtness are discussed. According to bibliographic data ae maximum tightness with this type of vessel is that cor- esponding to a leak velocity of $1/100$ of the vessel air volume uring 24 hours. The analysis of the errors committed in ne methods which have been used for the measurement of ne leak velocity showed that the dynamic method, which is escribed, should give the best results. With this method a eak velocity of 2.26 ± 0.23% of the vessel volume per 24 ours was obtained. (J.S.R.)

16759 SOME PROBLEMS OF IRRADIATION EXPERIMENTS IN THE DEVELOPMENT OF NUCLEAR FUEL ELEMENTS. F. Berger. Jaderná energie, 7: 37-42 Feb. 1961). (In Czech.)

Irradiation experiments using fuel element models or uel samples in a research reactor are discussed. Special ttention is given experiments in low and medium neutron lux. Basic equations for the calculation of thermal power, fuel burnup and temperature in the fuel axis are reported. The influence of fuel enrichment and model dimensions on these parameters is shown. (auth)

16760 RAPID FLUX MAPPING IN MTR FUEL ELEMENTS. Robert Steinberg (Lewis Research Center, Cleveland). Nucleonics, 19: No. 4, 102; 104(Apr. 1961).

Rapid mapping of the neutron flux between plates of MTR-type fuel elements is possible with an instrument designed and built for use with the 60 Mw Plum Brook Research Reactor. The power density of a 22-fuel-element core such as that of Plum Brook can be completely surveyed in 10 hr or less while the reactor is operating at low power. (auth)

16761 FAST REACTOR SAFETY STUDIES IN TREAT. A STATUS REPORT. C. E. Dickerman, E. S. Sowa, and D. Okrent (Argonne National Lab., Ill.). Nucleonics, 19: No. 4, 114; 116; 118; 121; 150(Apr. 1961).

Results of tests in TREAT on Fermi-1 and EBR-2 Mark-1 fuel elements are reported. Neutron flux pulses from 0.2 to 30 sec duration are applied to the test fuel elements, with temperatures from 950 to 1015°C being achieved. The extent and nature of the fuel element failures, both in air and stagnant sodium, are reported. (T.F.H.)

16762 THE LIQUID HYDROGEN CELL IN THE EL3 SACLAY REACTOR. B. Jacrot, A. Lacaze, and L. Weil (Universite, Grenoble, France and Centre d'Etudes Nucleaires, Saclay, France). p.214-17 of "Proceedings of 10th International Congress of Refrigeration, Volume 1, Copenhagen, 1959." London, Pergamon Press Ltd., 1960. (CEA-1361). (In French)

The design and performance of a liquid hydrogen cell for obtaining slow neutrons in the EL3 are given. (auth)

16763 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to Vitro Corp. of America). British Patent 862,145. Mar. 1, 1961.

A research reactor using H_2O as moderator is designed with improved control means. In this reactor, the core is so constructed that it is capable of sustaining a chain reaction at a temperature within the range 32°F to a maximum operating temperature which is below 212°F (preferably 70°F). The control means resides in the temperature control means, which maintains the core at a temperature below or above the maximum operating temperature to produce or prevent a chain reaction, respectively. The control means may be a cooling-heating jacket in which fluid is circulated. (D.L.C.)

WASTE DISPOSAL AND PROCESSING

16764 (IDO-14537) INTERIM REPORT ON THE CALCINATION OF ZIRCONIUM FLUORIDE WASTE SOLUTIONS. R. L. Hickok and J. S. Madachy (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 8, 1961. Contract AT(10-1)-205. 13p.

Laboratory experiments indicated that conversion of aqueous zirconium fluoride wastes to a dry, insoluble residue by a calcination process may be feasible. The process involves precipitation of the metal ions and fluoride with CaO, followed by calcination of the slurry at temperatures from 300 to 600°C. The data indicated that the optimum conditions for producing an insoluble residue while, at the same time, volatilizing a minimum amount of fluoride are a temperature of about 500°C, and an amount of added CaO chemically equivalent to the fluoride present in the aqueous waste solutions. (auth)

16765 (NP-9961) SOME THERMAL ASPECTS OF THE STORAGE OF GROSS FISSION PRODUCTS. A PROPOSAL FOR HIGH LEVEL WASTE CONTAINMENT, USE, AND FINAL DISPOSAL (thesis). John A. Weissenfluh (New York Univ., New York. Coll. of Engineering). Apr. 1957. 45p.

The thermal characteristics of gross fission products were examined to ascertain the amount of available heat from storage facilities. Means of utilizing this heat are examined both as to the form of the fission products and the design of the system. A system of 5 ft or 7 ft diameter tanks, compartmentalized at 15 ft intervals and half-filled with fission products, is suggested as a heat source for producing steam. Studies were made on gamma absorption in such a system. The possible use of Cs^{137} and Sr^{90} as individual long-range heat sources was also examined. Calculations were made to determine the magnitude of the thermal problem in the final solid disposal of radioactive wastes. (C.H.)

16766 (AEC-tr-4225) STUDIES ON LIQUID ENTRAINMENT. Nobuo Mitsuishi, Sadahiro Sakata, Yuji Matsuda, Yukata Yamamoto, and Yoshitoshi Oyama. Translation of three papers from J. At. Energy Soc. Japan, 1: 363-9(1959); Kagaku Kogaku, 22: 680-6(1958); and Kagaku Kogaku, 23: 647-54(1959). 52p.

Separate abstracts have been prepared for the three papers.

16767 (AEC-tr-4225(p.1-18)) THE LIQUID ENTRAINMENT AND ITS REMOVAL OF [IN A] LARGE-SCALE EVAPORATION UNIT. EVAPORATION OF RADIOACTIVE LIQUID WASTE. Nobuo Mitsuishi, Sadahiro Sakata, Yuji Matsuda, and Yutaka Yamamoto. Translated from J. At. Energy Soc. Japan, 1: 363-9(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 8319.

16768 (AEC-tr-4225(p.19-36)) STUDIES ON LIQUID ENTRAINMENT. EVAPORATION OF RADIOACTIVE LIQUID WASTE. Nobuo Mitsuishi, Yuji Matsuda, Yutaka Yamamoto, and Yoshitoshi Oyama. Translated from Kagaku Kogaku, 22: 680-6(1958).

The bursting of gas bubbles was experimentally studied, using air, distilled water, and solutions of butyric acid and glycerin. Large drops were caught on a slide coated with a mixture of vaseline and light mineral oil, and the diameters of the drops were measured through a microscope. The relations between the diameter of the gas bubble and the height which the drops entrained above the gas-liquid interface, and the diameter of the drops are shown. The velocity of the rising drops was calculated. A general theoretical formula was derived for the case in which several drops were formed from a single bubble:

$$\sum_{i=1}^{N} v_i = K \left(\frac{\sigma}{\rho_w}\right) \frac{1}{r^{5/2}}$$

where, N is the number of drops. Comparison of the theoretical values of the velocity of drops with the experimental data may verify the adequacy of the equation, except for the case of liquids with high viscosity. A natural circulation type evaporator for radioactive liquid waste disposal was constructed, and the over-all decontamination factor was obtained. The factor ranged over 10^6 to 10^7 for vapor mass velocities of 200 to 3000 kg/m^{2}hr. (auth)

16769 (AEC-tr-4225(p.37-52)) ON LIQUID ENTRAINMENT AND ITS REMOVAL. DECONTAMINATION CHARACTERISTIC OF EVAPORATION UNIT. Nobuo Mitsuishi, Yataka Yamamoto, and Yoshitoshi Oyama. Translated from Kagaku Kogaku, 23: 647-54(1959).

Considerations are given for the decontamination factors in an evaporator, a pipe line, and a cyclone, pertaining to the pilot plant. The decontamination factor in the evaporator proves to be mostly independent of the height of vapor space (0.6 m and 1.1 m, respectively). Theoretical calculation from the jet velocity at which a single gas bubble bursts demonstrates the results obtained experimentally. The over-all decontamination factor is found to be between 10^7 and 10^8. The drag coefficient of the glass-fiber-packed bed proves to obey the Langmuir and Iberall's equation. The decontamination factor without downtake indicates approximately the same value as in a natural circulation type evaporator, when the mass velocity is large. The mass velocity at the maximum decontamination factor is larger than in the natural circulation type. Considering the presence of demisters which are usually installed in industrial scale equipment, the mass velocity at the optimum over-all decontamination factor may be set within 2000 to 3000 kg/m^{2}hr. (auth)

16770 TREATMENT OF RADIOACTIVE LIQUID WASTES BY ION EXCHANGE. Shigehisa Iwai and Toshiki Oshio (Kyoto Univ.). J. At. Energy Soc. Japan, 3: 117-28 (Feb. 1961). (In Japanese)

The treatment of radioactive liquid wastes by ion exchange has been widely adopted, alone or combined with other processes. Among various ion exchangers, inorganics are more economical than organics if no regeneration is practiced in the process. Coprecipitation and pH control may be added to the process with cation exchangers, allowing selectivity of specific nuclides. Desalting systems in combination cat-

on and anion exchangers give higher decontamination factors, while the ion exchange membrane treats highly concentrated wastes more economically. In general, low level wastes can be treated with cheaper cation exchangers only, by the coprecipitation method. The decrease of exchange capacity by strong radioactivity is especially noticeable on anion resins. Studies were made of the removal of radioactivity from wastes by soils or soil forming minerals. By utilizing soils, the wastes may be disposed directly to the ground. The past history, the present status, and the future prospect of waste treatment by ion exchange are reviewed, summarized, and discussed in six categories. (auth)

16771 PROCESS AND DEVICE FOR THE PREPARATION OF CESIUM-137. (to Commissariat a l'Energie Atomique). Belgian Patent 570,747. Priority date, Sept. 9, 1957. (In French)

After extraction of U and Pu from irradiated fuel elements, the waste solutions are treated with phosphotungstic acid. The precipitated Cs phosphotungstate is treated with a saturated solution of baryte, yielding pure CsOH. Ammonium ions are eliminated by heating. The equipment, fully remote-controlled, consists of a stainless steel precipitation-decantation vessel enclosing a rocking bucket. (EURATOM)

16772 RADIOACTIVE WASTE DISPOSAL. Alberti R. St. Andreasberg. Belgian Patent 575,023. Priority date, Oct. 15, 1958. (In French)

A mixture of granulated barite (85%) and some other finely dispersed material can be impregnated with the radioactive waste liquor in a filter or ion exchange column. The liquor can also be used as binder for a mixture of barite and Portland cement. (EURATOM)

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